Cement MILL SECTION of

Concrete

Vol. 25 SEPTEMBER, 1924 No. 3

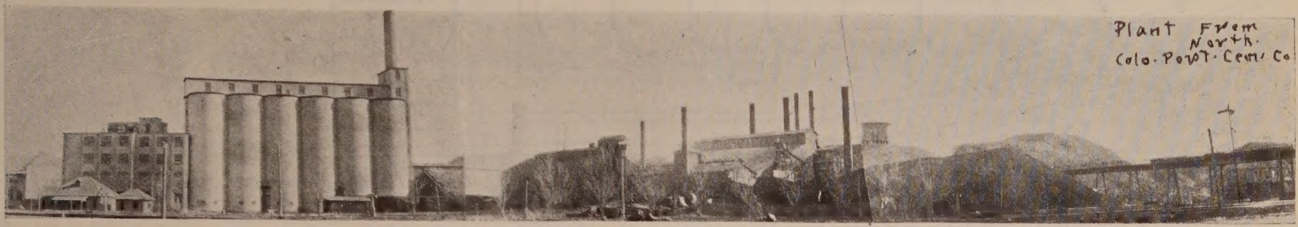


Fig. 1—General View of Colorado Portland Cement Plant from the North with the New Stock House on the Left

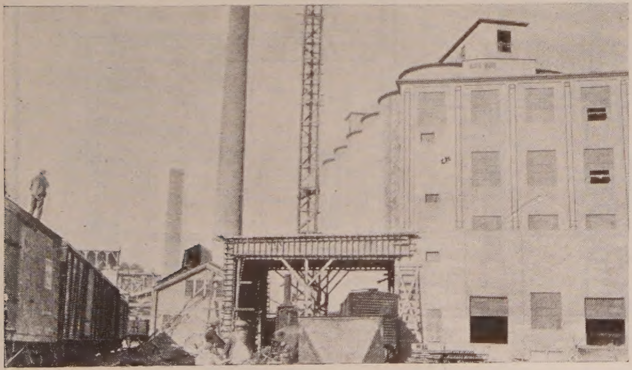
Colorado Portland Cement Co. Erects New Silo Storage Bins

By E. J. Strock
Supt. Colorado Portland Cement Co.

The Colorado Portland Cement Co. found itself cramped by an old type of storage bins, that were large and rectangular with flat bottoms and insufficient openings in the floor for reclaiming the cement. The pack house had not enough floor space and was poorly arranged. There was only one track on each side for loading cars. In order to remedy these faults a new four-story and basement pack house and 12 circular bins with 5 small bins in the interspaces were built and have recently been put in operation.

Reinforced concrete piles for the foundation were made by F. T. Leeder and driven to refusal by E. S. Whitney & Son, as many as 1400 blows being struck with a 3000-lb. hammer until the piles were solidly bedded in the boulders and gravel, the plant being located in a former river bed. On these piles the packing house, shown in the accompanying illustrations, was built.

The new structure is located immediately adjoining and to the east of the old pack house. It is of massive reinforced concrete construction and has four working floors besides the basement. Sacks are taken to the top floor by elevator and work their way down through the various stages of counting, sorting, cleaning and repairing and after being tied, slide in a chute to their place alongside the four Bates packers. When the sacks are



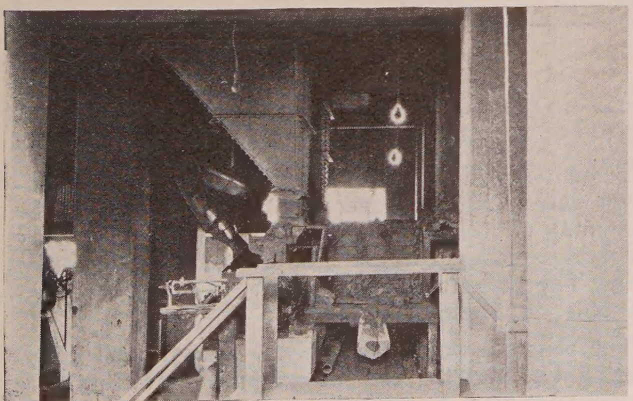


Fig. 2—East End of Stock House
Fig. 3—View Looking Along a Loading Belt at Bates Packers

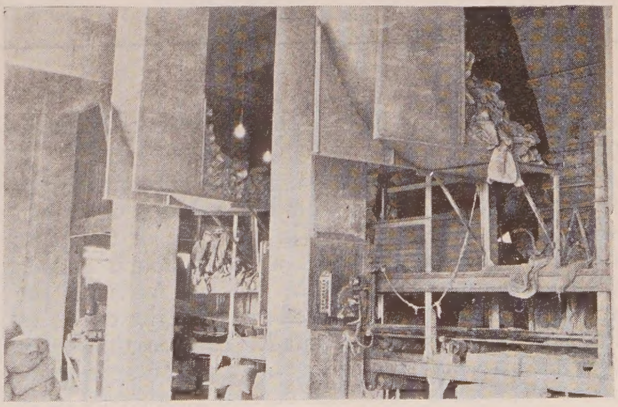


Fig. 4—Bates Packers Installed with Conveyor for Filled Cement Sacks Below and Chutes for Empty Sacks Above

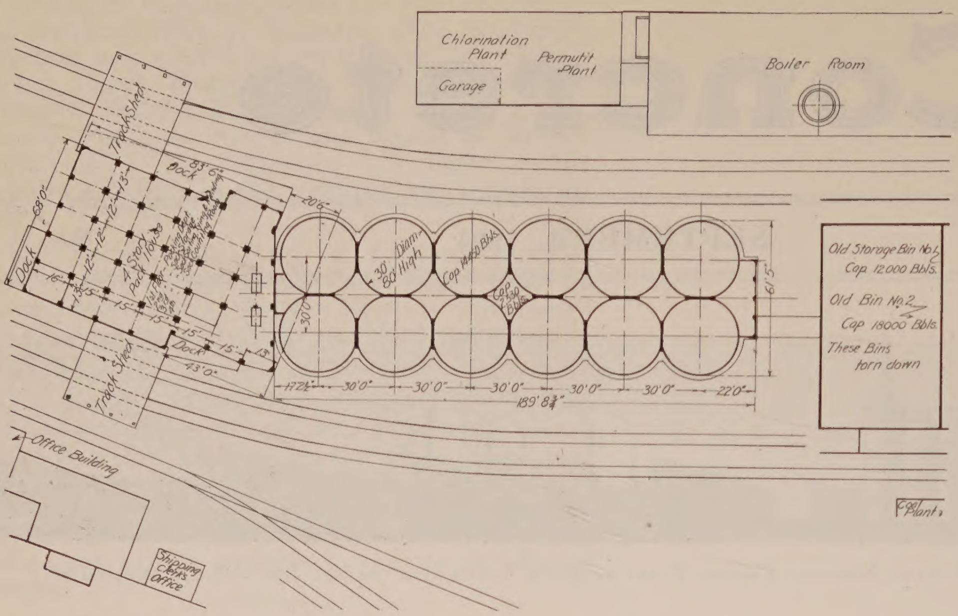
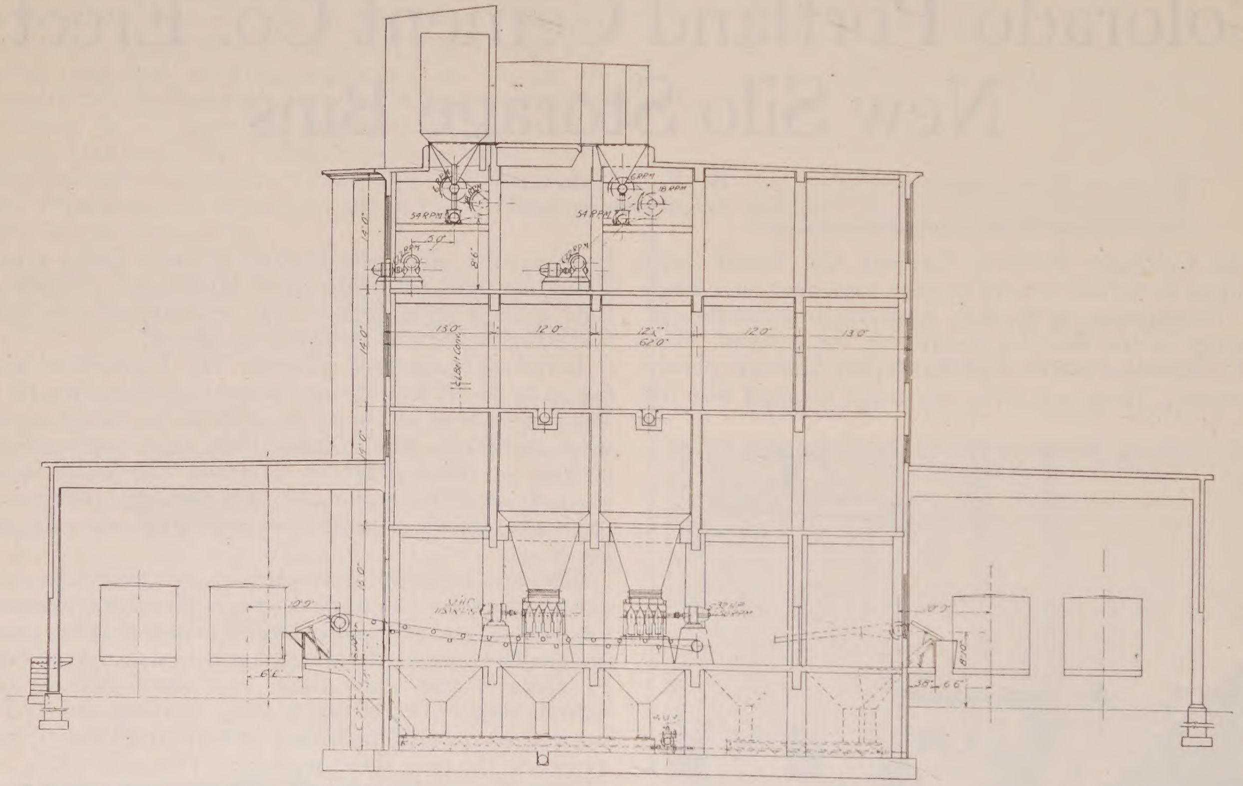


Fig. 5—General Plan of Cement Storage and Pack House Storage Capacity, Total Volume 727,560 cu. ft. Effective Volume, 683,800 cu. ft. Total Capacity 182,500 bbls.

Fig. 6 (Below)—Cross Section Pack House and Shipping Shed



filled they pass out on belts to the cars to two tracks on each side.

As soon as the new pack house was in operation, the old pack house and two of the four old bins were torn down. Piles were driven as in the case of the pack house and on top of the piles a heavy floor slab was poured. On top of this slab, column walls of the shape of the bins were poured to a height of 22 ft. before bin bottoms were poured. It is in this space under the bins that the conveyors and bin spouts are located. The walls were then carried another 80 ft. in height and covered by a concrete roof. Above the roof are the conveyor gallery (popularly called the "dog house" in plants), and the head of the elevator shaft, the top of the latter being 128 ft. above the floor slab.

Cement is delivered from the finish mills by a conveyor carried on a bridge over the space where the remaining two old bins stood. This space crossed by the bridge could, if desired, be utilized for more new bins. The present storage capacity is for about 200,000 bbls. of cement.

The concrete work was done by the Burrell Engineering Co. and the cement company's interests were looked after by J. E. Griffith, engineer for the Colorado Portland Cement Co.

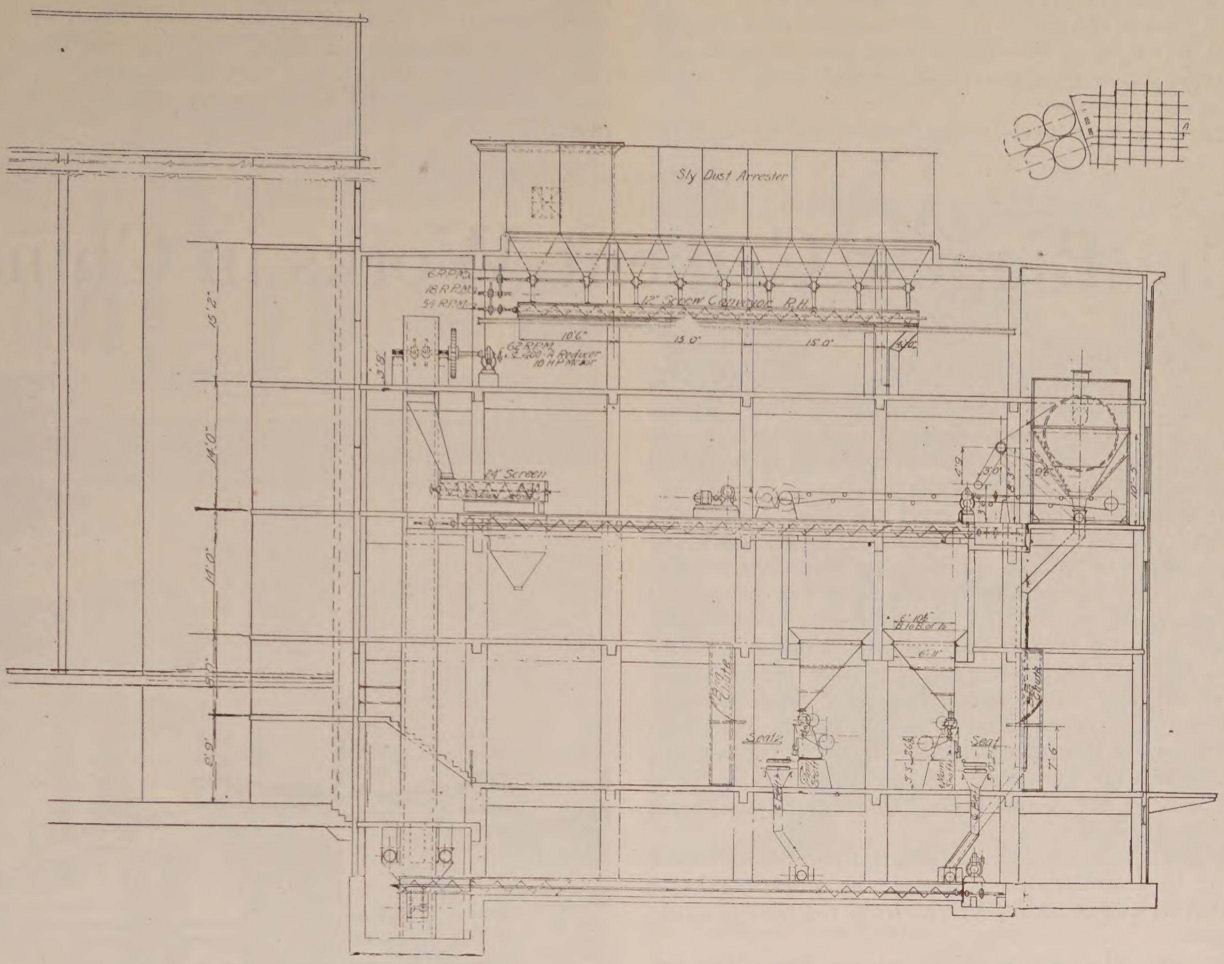


Fig. 7 (Above)—Longitudinal Section Pack House

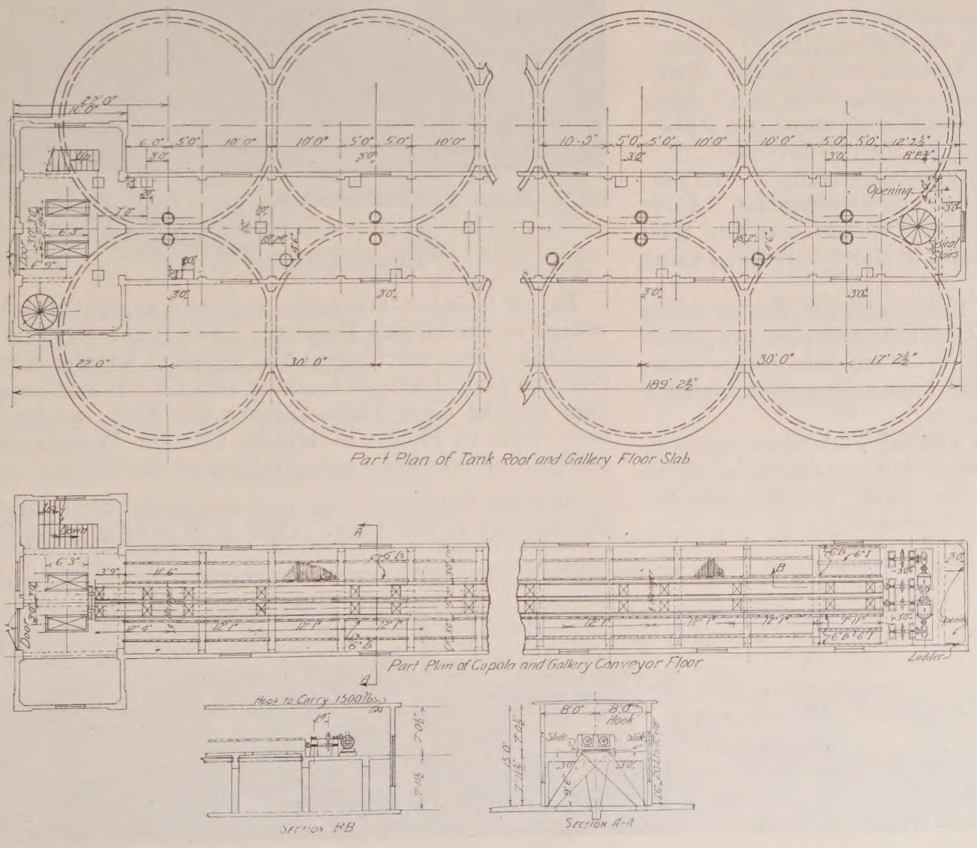


Fig. 8—General Plans of Gallery Over Silos

Concreting materials were found on the company's property and the concrete was elevated in a 166 ft. tower, thence chuted to concrete buggies and wheeled to the slip forms. Slip forms were used on both silos and pack house and work was carried on during the cold winter months.

Dust collection installations were made to keep the air clean and an abundance of light is provided in the pack house. The tracks in the yards were all relocated to reduce curves and allow loaded cars to readily drop down from the pack house. The entire installation is now in use and has proved very satisfactory in every way. In addition the buildings are attractive in appearance.

The Biggest Cement Works in China

By M. H. Chou, M. S.

One of the most successful enterprises in the field of chemical industry ever operated by the Chinese people is the Chee Hsin Cement Co., Ltd., which was founded in September, 1906, and registered in the Board of Agriculture and Commerce at Peking.

The Chinese people have used lime, burned gypsum and brick as their building materials for thousands of years. As the process for cement manufacture was invented and perfected by the Western people, it was gradually introduced into China. The Green Islands Cement Works was the first Chinese cement plant, built in Hongkong in the year 1886 by the Kailan Mining Administration, an Anglo-Chinese concern. The second one was started in Tangshan around 1900. Because of lack of demand for cement, the company at Tangshan became bankrupt and was later sold to the Chee Hsin Co., a purely Chinese capitalized concern.

The plant is located at Tangshan, Province of Chihle on the Peking-Mukden Railway, 74 miles northeast of Tientsin and 91 miles by rail from the port of Chinwangtao.

The raw materials used—limestones and clay—are located under the plant. The coal is from mines of the Kailan Mining Administration. A small amount of gypsum from South-Central China is added to the finished product to regulate the setting time of cement.

The mill is of brick construction and consists of two plants, which have two units each. The older plant with machinery driven by steam consists of two 100-ft. rotary kilns, making cement by the dry process.

The new plant is employing electrically driven machinery, making cement by the wet process. First the limestone is roughly crushed to 2-in. size and then mixed with slurry and ground in short ball mills, using steel balls.

The mixture passes to tube mills for fine grinding and then into slurry tanks where samples are taken for analysis. Then the slurry is fed into rotary kilns 150 ft. long. The clinker comes out in air-cooled steel coolers.

The company also owns a small brick plant near the cement works and a tile and pottery plant which turns out sewer pipes, cuspidors, toilet articles, electric porcelain and other heavy stoneware.

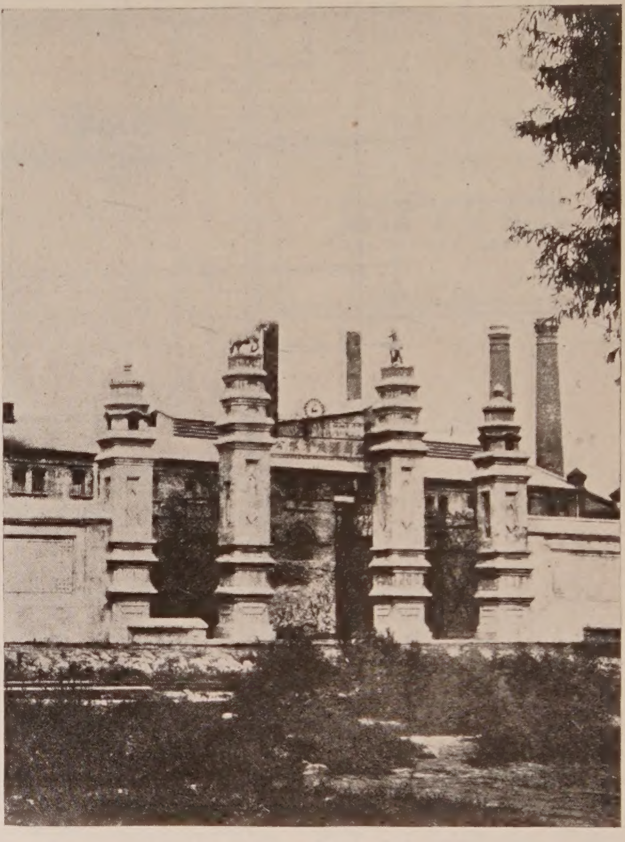


Fig. 2—Front Gate, Tangshan Works

Tayeh Cement Works

Tayeh Cement Works is situated at Shi Hui Yao village in the Hupeh Province. The plant was put up in 1910. The machinery was supplied by the former German firm of Arnold Garberg and Co. It was bought over by the Chee Hsin Cement Co. Ltd., under the new name of Hwa Chi Hupeh Cement Works. The reorganized company is capitalized at one million taels.

Suitable limestone and clay are quite abundant in the vicinity of the plant. The coal used is brought a

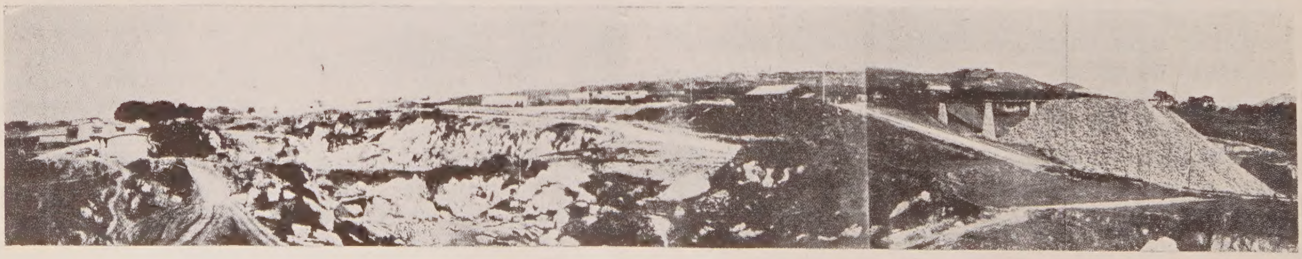
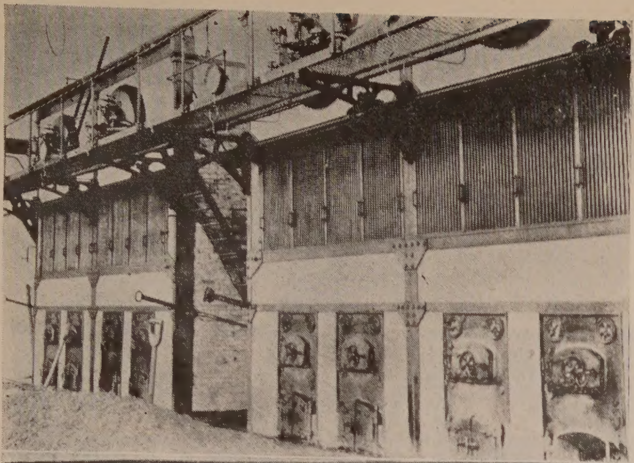
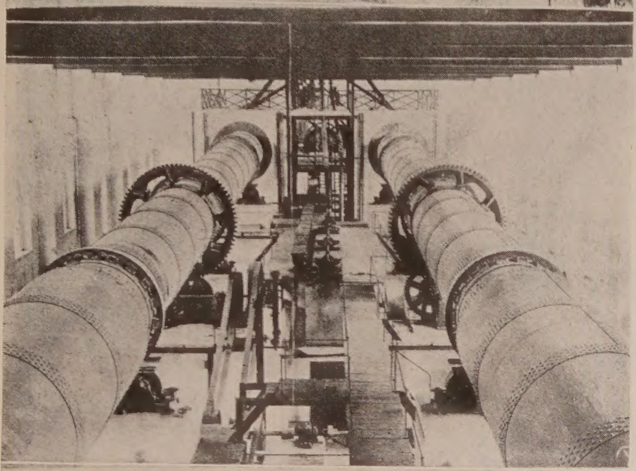


Fig. 1—Full-View of the Chee Hsin Cement Works, Tangshan





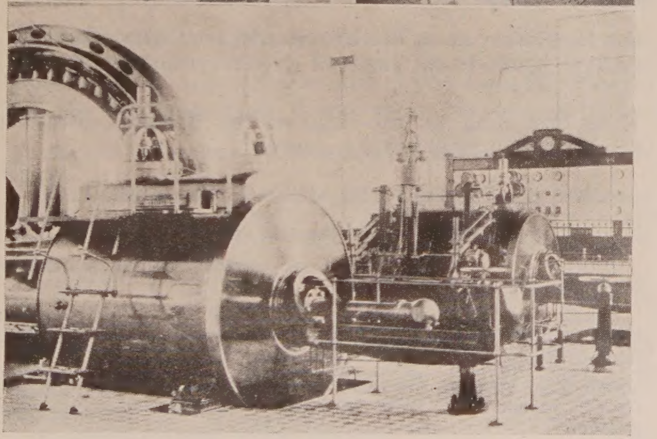
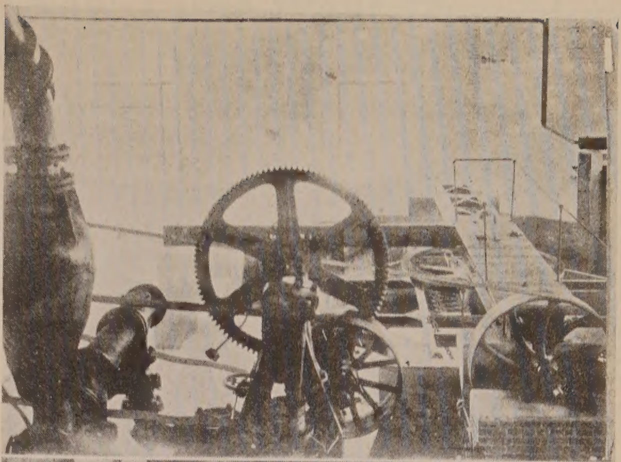


Fig. 3—Boiler Room, Tangshan Works
Fig. 4—Rotary Kilns, Tangshan Works
Fig. 5—Engine Room, Tangshan Works



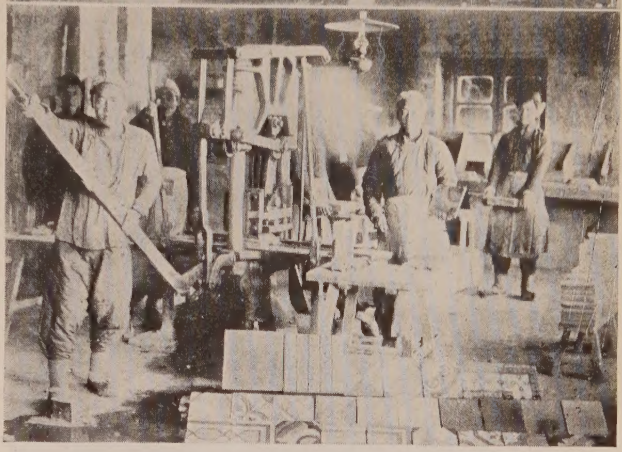


Fig. 6—Mill Room Wet Process Plant, Tangshan Works
Fig. 7—Mosaic Tile Factory

distance of 1255 miles from the Kailan Mining Administration.

CHEMICAL ANALYSIS

The results of the chemical analysis of Chee Hsin Cement at the Tangshan Laboratory are as follows:

Insoluble residue	.30%
Silica	22.20%
Alumina	8.22%
Ferric Oxide	3.31%
Lime	63.59%
Magnesia	1.45%
Sulfuric Acid Anhydride	.43%–1.50%
Alkalies, etc.	.43%
	100%
Loss on ignition of above samples	1.80%

TANGSHAN LABORATORY DAILY AVERAGE TEST RESULTS

FINENESS

.4% Residue on sieve No. 76 (5776 meshes per sq. in.)
11.5% Residue on sieve No. 180 (32400 meshes per sq. in.)

SETTING TIME

Initial setting	3 hours
Final setting	7 hours.

SOUNDNESS

Le Chatelier Test, Expansion: 3M/M.
Pat Test, cold and hot: all quite sound.

SPECIFIC GRAVITY, 3.12

TENSILE STRENGTH

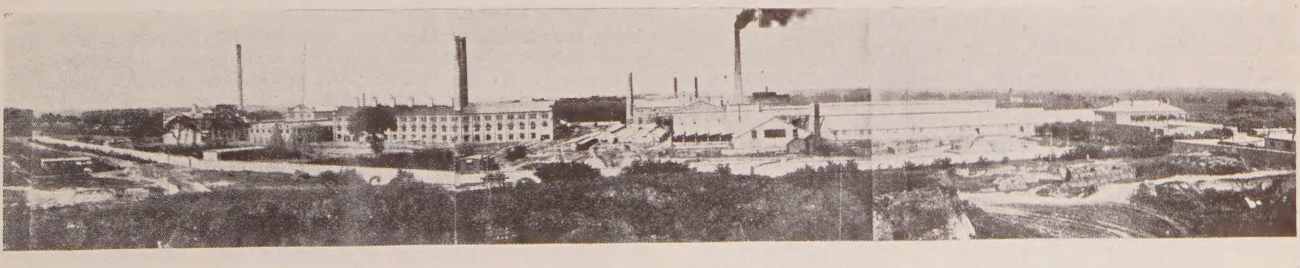
	After 7 days	After 28 days
Neat Cement	690 lbs. sq. in.	760 lbs. sq. in.
Cement Mortar (1:3)	260 lbs. sq. in.	310 lbs. sq. in.

CRUSHING STRENGTH

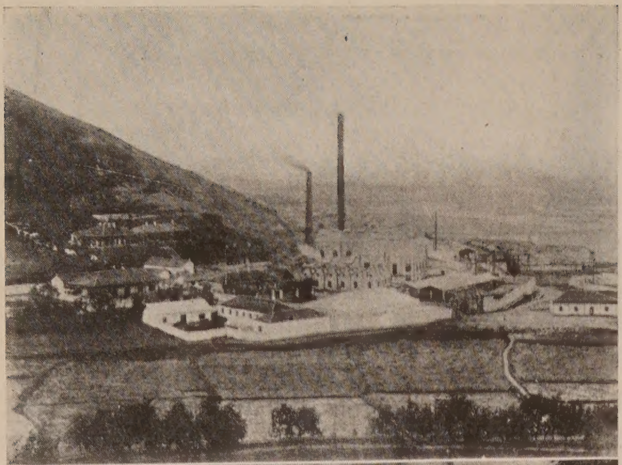
Tested on 3 in. cubes of tamped mortar.

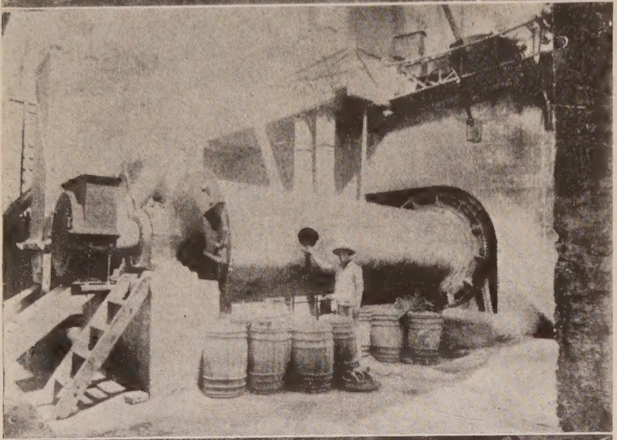
	After 28 days in water	After 7 days in water 21 days in air
Cement mortar (1:3)	3743 lbs. sq. in.	4711 lbs. sq. in.

Further proof of the soundness of the quality of cement manufactured by the company is the fact



—The Biggest Cement Works in China





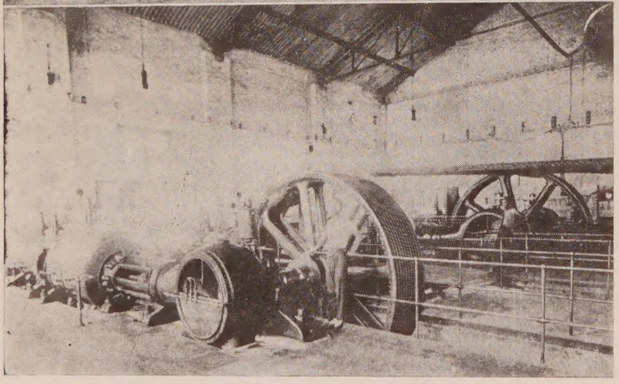


Fig. 8—Panoramic View, The Hwa Kee Hupeh Cement Works, Hwangshihkang

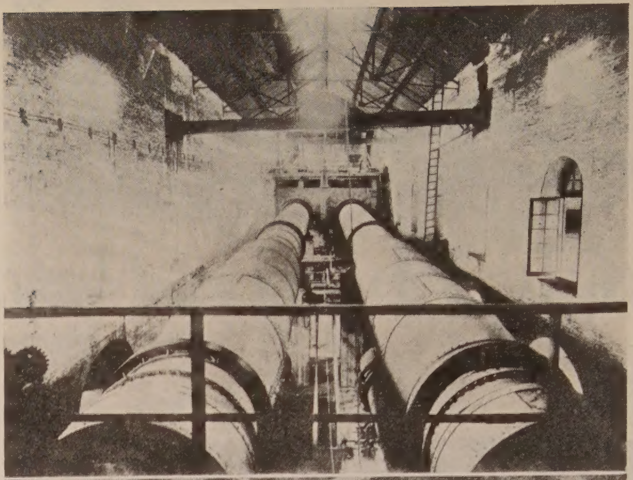
Fig. 9—Cement Barreling Room, Hwa Kee Hupeh Cement Works

Fif 10—Engine Room, Hwa Kee Hupeh Cement Works

that it has been widely used throughout China for various purposes as shown by the accompanying illustrations.

The company has organized a strong sales organization by appointing about 40 agencies in various places throughout China.

During the European War the importation of cement from foreign countries was practically nil, thus giving the Chee Hsin Cement Co. an opportunity for making a fortune. At that time one barrel of cement was sold at five or six gold dollars. Because of the huge profits made in cement manufacture several new cement companies such as the China Portland Cement Co., the Shanghai Portland Cement Co., and Ta Hu Cement Co. were started. Because of the keen competition to be anticipated the head office of the Chee Hsin Cement Co. has decided to open South China Sales Bureau at Peking Road, Shanghai, with Mr. King Pon Ping as the head of the Bureau. Present production is.5000 barrels a day.



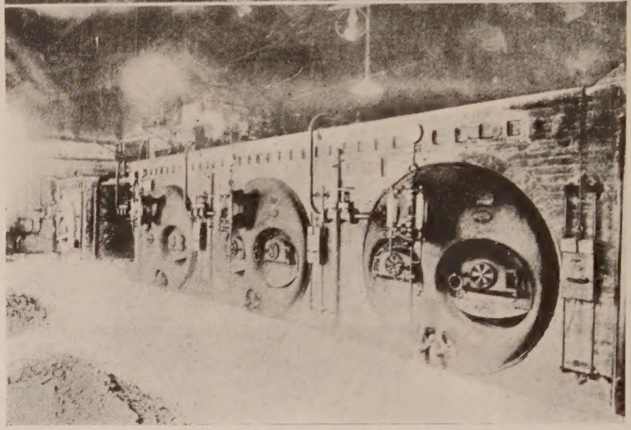


Fig. 11—Rotary Kiln, The Hwa Kee Hupeh Cement Works

Fig. 12—Boiler Room, The Hwa Kee Hupeh Cement Works

CONSTITUTION OF THE CHEE HSIN CEMENT CO.

(Amended in the year of 1920)

Article 1. Name: The name of the company shall be called "the Chee Hsin Cement Co., Ltd."

Article 2. Incorporation: The company was incorporated in the year of 1903 in accordance with the official regulations governing the incorporation of limited liability companies.

Article 3. Object: The object of the company is to manufacture cement, cement tiles, sewer pipes, colored bricks and other allied products.

Article 4. Place: The plant is located in Tangshan and the head office of the company, at Tientsin.

Article 5. Trade Mark: The brand of cement adopted by the company is Horse brand.

Article 6. Lekin Exemption: Cement produced by the company is only liable to 5% ad. valorem duty and exempt from all Lekin imposition.

Article 7. Capitalization: The company is capitalized at twelve million Mex. dollars, having 1,200,000 shares of all common stocks at $10 per share. For any future enlargement of the company, the increase of the capital can only be authorized at an extraordinary meeting.

Article 8. Stockholders Meeting:

(a) Ordinary Meeting. Ordinary meeting of the company shall be called in February every year.

(b) Extraordinary Meeting. Extraordinary meeting of the company shall be called at the discretion of the board of directors.

Article 9. Voting Power: Any stockholder who has passed the age of maturity is entitled to vote.

(b) Plurality of votes shall decide the election.

(c) The Board of Directors shall consist of seven persons, the general manager and vice manager being the chariman and vice chairman of the board of directors.

(d) Those stockholders who possess 1,000 shares with their real names registered on the stocks are eligible to the board of directors.

(e) The general manager and vice manager of the company shall be elected from the board of directors.

(f) Two auditors of the company shall be elected from those who

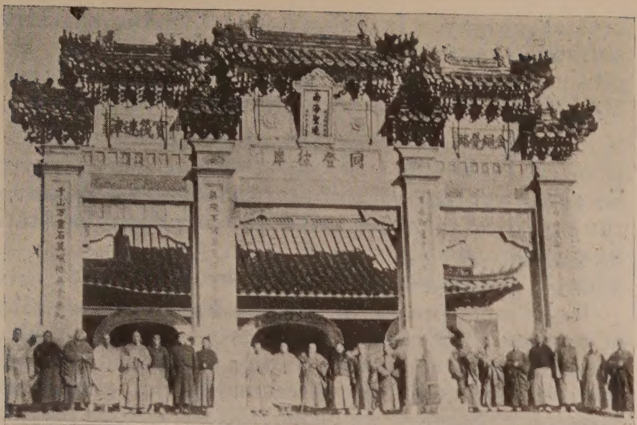


Fig. 13—An Honorary Portal, Known as The Way-End First Honorary Portal 56 ft. in Length x 44 ft. High, at Pooto Mountains (South Sea, Ningpo), Built with Chee Hsin Cement

Fig. 14—The Cheng Foong Pagoda in the Province of Anhui

possess 1,000 shares of stock with their real names registered on the stocks.

(g) The period of service for the general manager and vice manager shall be four years and that for the board of directors, 2 years and that for auditors, one year. However these officers are eligible for reelection.

Article 10. Account: The account of the company shall be rendered quarterly. The final report shall be issued at the end of the year.

Article 11. The bonus of the company shall be declared in March and calculated by putting aside one twentieth of the net profit as reserve fund, deducting 4% interest on all the stocks and dividing the remaining sum into 14 parts.

(a) 2 parts as bonus to the office employes.
(b) 2 parts as bonus to the general manager and vice manager.
(c) 3 parts, as reserve fund for depreciation of machinery.
(d) 7 parts as bonus to all stockholders.

Article 12. Amendment: Any amendment to the constitution shall be passed at the extraordinary meeting of the stockholders.

Russian Cement Industry Handicapped

The Russian cement industry is having considerable difficulty at present in disposing of its output. The prospects are that it will close the fiscal year with large stocks on hand. Production for the present fiscal year was fixed at 1,900,000 long tons, not including the output of several small plants, estimated at 360,000 tons. On October 1, 1923, stocks on hand amounted to 400,000 tons. With this carry over, sales in 1923 should amount to 2,700,000 tons, but up to April 1, 1924, only 1,200,000 tons had been disposed of. Of the 11 prominent cement plants in Novorossisk and its vicinity only 2 at present are in operation, the balance being shut down. (Abstracted by the Eastern European Division from Der Ost Europa, Markt, June 1.)—*Commerce Reports*

New Lime Plant Opened in New Brunswick

Probably no other sections of eastern Canada have developed so markedly during the past twelve years insofar as the manufacture of lime is concerned as the territory along the Tobique River and the territory along the Kennebeccasis River. Along the Tobique River, and particularly at Plaster Rock, many lime manufacturing plants have been opened. The Fraser Companies were instrumental in opening new plants along the Tobique including a number at Plaster Rock. The lime is shipped 25 miles west over the Tobique branch of the Canadian Pacific Railway to Perth-Andover and thence to the United States. Another route is via Canadian National which runs through the territory from Prince Rupert, B. C., to Moncton, N. B. over a transcontinental line. Shipments can be made entirely over this system which includes the former Grand Trunk.

Independent operators have also opened plants along the Tobique, there being an almost inexhaustible deposit of lime rock along both sides of this river, which is a tributary of the St. John River in the northernmost section of the province of New Brunswick.

Before the World War, there were very few lime manufacturing plants along the Kennebeccasis River which is also a tributary of the St. John River but located in the southernmost section of New Brunswick. The biggest plant now located along this river and one of the biggest lime manufacturing plants in the eastern provinces is that of the New Brunswick Lime Co. at Brookville, N. B. This concern has been a heavy manufacturer and shipper of lime. The plant is ideally located, being on the St. John-Moncton branch of the Canadian National, and practically a few yards from the railroad tracks. The equipment is most modern in every respect. The company has built a narrow gauge railroad connecting the lime rock operations with the plant. The lime rock is said to be excellent. A few miles east is the new plant of the Clairmont Lime Co., organized by C. H. Peters' Sons of St. John, N. B. This plant is smaller than that of the New Brunswick Lime Co. and is located on the Canadian National. Shipments of lime to the markets are greatly facilitated by the close proximity of the railroad.

Fluorspar in the Cement Industry

Among the uses for fluorspar, enumerated in the report of the *United States Geological Survey* in *Mineral Resources of the United States, for 1923,* is its use in extraction of potash from feldspar and from flue dust of portland cement works.

The market for the bulk of fluorspar sold in the United States depends upon the condition of the steel industry and the demand fluctuates with the rise and fall in the production of basic open-hearth steel. From 80 to 85% of the fluorspar produced in the United States is used as a flux in the production of steel by the basic open-hearth process. This flux is used principally for giving fluidity to slags that are otherwise too viscous, but at the same time, it facilitates the passage of impurities such as sulfur and phosphorus into slag. During 1923, 149,115 short tons of merchantable fluorspar was recovered in the United States and 121,188 short tons shipped from mines in the United States.

Total imports of fluorspar from all countries into the United States amounted to 42,226 short tons in 1923 at an average value of $10.24 per ton.

New Laws Govern Fine Grinding

By Charles E. Blyth
Geoffrey Martin
Harold Tongue

A paper prepared for presentation at the International Cement Congress, London, April 22 and 23, 1924. Courtesy, *The Structural Engineer.*

The cost of grinding the raw materials, coal and finished cement is a considerable proportion of the total cost of cement manufacture. With a view to reducing this cost of grinding, the British Portland Cement Research Association has carried out a comprehensive research dealing with some of the fundamental principles governing the crushing of materials used in cement manufacture to a greater degree of fineness.

So far as can at present be ascertained from a careful search through the literature dealing with the crushing of materials, the art of grinding has been an empirical one. Although an enormous mass of data has been accumulated, no underlying laws have been either sought for or detected, which would serve to bring order and simplification into the apparently chaotic mass of detail. Apparently very little systematic research has been undertaken with this object in view—no doubt because of the expensive nature of the machinery and appliances needed, the large amoung of labor necessary in coordinating the data, and the expensive nature of the highly trained technical staff necessary for coordinating the research. Recently, however, as the result of very costly experiments carried out during the last two years by the British Portland Cement Research Association, several general underlying laws have been discovered, which laws, it is thought, will reduce the whole subject to an exact mechanical science, and thus achieve for the art of grinding what has long since been done for steam and electricity. In other words, just as the engineer knows the amount of electrical energy or steam necessary to perform a given amount of work under definite conditions, a development of this research would enable one in future to estimate the theoretical amount of work required to reduce a given material to a given degree of fineness under given conditions. It will thus be possible to deduce the efficiency of any grinding machine.

The importance of this development in the gold mining, pigment, cement, ceramic and other industries—which depend so largely upon the economical production of materials in a state of fine division—will be apparent when we reflect on the great advances which occurred in the sciences of electrical and steam engineering, when the underlying laws were discovered.

The following is an outline of the line of thought which, by erecting a frame-work of definite underlying laws capable of mathematical treatment, will, it is hoped, achieve the above results in the near future. The work is confessedly incomplete as it is in the process of rapid development. Some of the laws are the result of laborious experiment, and may be considered to be definitely established. Others are the results of reasonable inference, and are in the process of being experimentally tested.

Law 1.—The average shape of the particles of sand produced in crushing remains the same whether they are large or small.

This conclusion was established by microscopic observation of both large and small particles of sand. It is also rendered probable a-priori by the known laws of crystallography. It follows that there is an *average* surface appertaining to the average diameter *d* of crushed sand particles, which average surface is a statistical constant of great stability.

In all *spheres* $S = 3.1416.d^2$
In all cubes $S = 6.d^2$

So also in all particles of *crushed sand* if d represents the statistical diameter and S the corresponding statistical *surface*, then $S = A.d^2$ . . . . (1)
where A is a factor which has to be determined.

To be more precise in defining S, suppose we select at random 1000 crushed sand particles, each of which has the diameter *d* when viewed in the microscope in the ordinary way of determining the microscopic diameter. Suppose we picked out these 1000 particles and measured the surface of each one exactly, and added together the surfaces so produced, calling the same 1000S. Then 1,000 particles each of statistical diameter *d*, picked at random, have a total surface 1000S. Hence one particle of statistical diameter *d* has a statistical surface S. As we are dealing with particles of *different shapes* this definition must be rigidly adhered to or mental confusion will ensue. In the case of all the cubes and spheres referred to above. they have all *precisely the same shape*, each to each, and therefore the statistical nature of the problem is eliminated.

The factor A differs for different materials, but for one material is a constant when a large enough number of particles is taken so that the law of probability may be applied. It is proposed to determine A for various materials other than sand, such as clay, chalk, chemicals and minerals. Having done this one would be in a position to calculate not only the best method of grinding, but also the amount of work required.

Law 2.—The work done in crushing sand is proportional to the new surface exposed.

This is *Rittinger's law*, and may be regarded as proved correct as a *first approximation* by very elaborate experiments carried out by the Research Association. The law may be expressed:

$W = B S$. . . . . (2)
where W is the work done, and S is the *new surface* produced.

B is a constant peculiar to each substance. When this law is not obeyed and new surface ceases to be produced, the excess work simply disappears in the form of heat.

Law 3.—The number of particles (N) produced of diameter x follows the compound interest law.

$$N = a e^{-bx}$$

where a and b are constants.

The discovery of a simple law relating to continuity of particle size in fine grinding (or the breaking up of larger particles into smaller ones), has long been a matter of considerable scientific and technical importance. By means of experiments extending over some years, the British Portland Cement Research Association has definitely ascertained that, so far as a crystalline substance such as "standard sand" is concerned, a definite law does undoubtedly exist, and may be defined mathematically as follows:

In a given weight of finely crushed sand, if N be the number of particles of diameter x, and if N and x be considered as variables, then in every case so far tested:

$N = a e^{-bx}$. (3)
where a and b are two constants characteristic of the particular sample treated.

Differentiating (3) we obtain:

$$\frac{dN}{dx} = b\,a\,e^{-bx} = -b.N \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

In other words, the rate of increase with decrease of diameter in the number of particles of a given degree of fineness is proportional to the number already present of that particular degree of fineness.

It is therefore possible to calculate the number of particles of any given diameter without going through the laborious process of sieving.

Another result of this law is that by combining it with laws (1) and (2) it now becomes possible to calculate exactly the amount of work required to produce powders of different degrees of fineness and thus reduce grinding to an exact science. The actual and theoretical efficiency of grinding machines can now be rigorously tested.

The physical significance of this is simple.

Consider a set of sand particles A. Fig. 1. By grinding each of the particles A gives rise to the same number k (in our illustration k = 2) of the smaller particles B, which in turn give rise each one to the same number *k* of still smaller particles C, and so on *all down the scale so far as we can pursue the matter by means of the microscope, with the ultimate production of colloidal particles.*

The law is probably the expression of the fact that crystals have a definite and fixed structure, and consequently break up when subjected to percussion or pressure in a regular and definite manner which follows a definite mathematical law when the number of particles considered is sufficiently large to allow of the application of the law of probability.

Connection between the work required in grinding and the total heat required to volatilize a substance.

The subject is of great scientific interest. For example, there is an obvious thermodynamical connection between the work done in grinding (i. e., producing small particles from large ones) and the amount of heat required theoretically to *gasify* the material. For—considering the simplest possible case—in gasifying a homogeneous solid material (without passing through the intermediate liquid state) we are merely reducing the material to particles of molecular dimensions. Whereas in ordinary grinding the same action is performed, but the particles remain of considerable size. It follows from this that a homogeneous crystalline substance such as the diamond (which requires a large amount of heat and a high temperature to gasify) would be expected to require the expenditure of much energy in reducing it to a fine state of division. Whereas a substance like ice (if reduced to an equally fine powder at a temperature below the freezing point of water) would require much *less* work to divide into smaller particles. This aspect obviously opens out a large field of research until now quite untouched; for example, there exists a large number of organic crystalline compounds whose heats of volatilization are known, and whose action under percussion or pressure could be investigated from this point of view Again, it is not without significance that most organic compounds are soft, and do not require much force to separate one particle from another, and at the same time are in general easy to gasify. Whereas minerals and metals in general require great power to separate into individual particles, and at the same time only become gaseous at high temperatures.

Experimental Work Elucidating the Above Laws

Law 1.—In order to establish the connection between the average diameter *d* of a particle of crushed sand and the resulting sufrace *S*, in the preliminary work it was assumed that the shapes of the particles were perfect cubes, then S = 6 d^2.

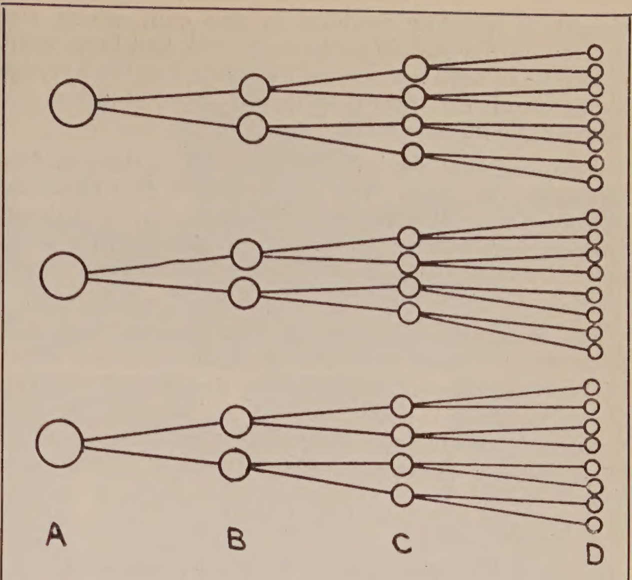


Fig. 1—Some New Laws in Connection with Fine Grinding

The diameter *d* was measured by direct microscopical observations, and many tens of thousands of measurements of small particles were thus recorded and the surfaces so produced were calculated. This gave us a comparative method of obtaining the surface. The *true* value of the factor A and therefore the actual surface presented by sand is now being determined by the following method:

A given weight of crushed sand (whose particles have been microscopically measured, and therefore the numbers of each diameter all up and down the scale are definitely known by (*Law* 3) is treated with dilute hydrofluoric acid of a definite strength and at a definite temperature with a definite rate of stirring for a fixed time, in a thermostat, and the loss of weight is estimated. A block of quartz of a definite geometrical shape (and therefore of an exactly known surface) is treated in precisely the same manner, and the loss of weight also noted. Then the rate of solution (i. e. loss of weight) is proportional to the surface in each case. It is, therefore, possible to calculate the absolute surface of the crushed sand. This work is now in active progress.

Experiments Made to Establish Law 2

In order to prove the law that the work expended was proportional to the new surface exposed, the following experiments were carried out, which have extended over nearly two years.

(1) *"Percusser" Experiments.*—The first experiments tried were made by dropping a weight M lbs. from a height h on to a small quantity of sand contained in an anvil. By varying the height of the mass M, blows of different intensity could be delivered, the work done in each case being

W = Mh foot lbs.

The sand was collected and the diameter of the particles measured and the total new surface S produced was then calculated by the formula.

S = 6 d^2

These experiments confirmed the view that the new surface increased in proportion to the work done.

(2) *18-in. Mill Experiments.*—A small 18-in. mill was fitted with a motor and with devices for exactly measuring the horse power expended and the number of revolutions. A known weight of sand was placed with a known

weight of grinding medium in the mill, which was rotated until a certain amount of work had been done. A sample of sand was then withdrawn and the average diameter of the particles therein was obtained by microscopic measurement.

Assuming that the particles were cubes, their surface was calculated from the formula $S = 6\ d^2$. The rotation of the mill was then resumed and additional samples withdrawn. Ultimately it was found that in general the increase of surface was proportional to the work done by the mill.

The Research program outlined above is being considerably extended, and it is probable that the whole of the underlying principles of dry fine grinding will be fully established within a few months. Once the principles are known and appreciated, it must necessarily lead to greater grinding efficiency, admittedly long overdue.

The Laboratories,
British Portland Cement Research Association,
Rosherville Court, Gravesend,
April 2, 1924.

July Cement Output Tops Record

14,029,000 Barrels

The statistics shown in the following tables issued by the Department of the Interior, and prepared under the direction of Ernest F. Burchard, of the Geological Survey, are based mainly on reports of producers of portland cement but in part on estimates. The estimates for July, 1924, were made necessary by the lack of returns from two plants. Production and shipments for the month are the highest on record, and stocks though decreasing rapidly since March, 1924, are greater than at the corresponding season of any earlier year.

Production, Shipments, and Stocks of Finished Portland Cement by Districts in July, 1923 and 1924, and Stocks in June, 1924, in Barrels

Commercial District	Production		Shipments		Stocks at end of July	
	July		July			
	1923	1924	1923	1924	1923*a*	1924
Eastern Pa., N. J. & Md.	3,216,000	3,418,000	3,484,000	4,205,000	2,814,000	2,734,000
New York	654,000	718,000	730,000	962,000	655,000	784,000
Ohio, Western Pa. & W. Va.	1,284,000	1,503,000	1,442,000	1,955,000	762,000	1,188,000
Mich.	783,000	1,058,000	895,000	1,100,000	320,000	529,000
Wis.*b*, Ill., Ind. & Ky.	1,817,000	2,166,000	1,848,000	2,570,000	497,000	1,953,000
Va., Tenn., Ala. & Ga.	626,000	962,000	583,000	1,109,000	234,000	606,000
Eastern Mo., Ia., & Minn.	1,259,000	1,333,000	1,544,000	1,633,000	1,014,000	2,110,000
Western Mo., Neb., Kans. & Okla.	956,000	935,000	1,062,000	993,000	873,000	1,137,000
Texas	397,000	409,000	411,000	442,000	187,000	264,000
Colo. & Utah	256,000	273,000	276,000	293,000	159,000	167,000
Calif.	1,083,000	986,000	1,069,000	1,025,000	169,000	326,000
Ore., Wash. & Mont.	289,000	268,000	368,000	327,000	397,000	520,000
	12,620,000	14,029,000	13,712,000	16,614,000	8,081,000	12,318,000

a Revised. *b* Began producing June, 1924.

Stocks of clinker, or unground cement, at the mills at the end of July, 1924, amounted to about 6,646,000 bbls. compared with 7,609,000 bbls. (revised) at the beginning of the month.

Production, Shipments, and Stocks of Finished Portland Cement, by Months, in 1923 and 1924, in Barrels

Month	Production		Shipments		Stocks at end of month	
	1923	1924	1923	1924	1923*a*	1924
January	*a*7,990,000	8,788,000	*a*5,628,000	5,210,000	11,477,000	*a*14,155,000
February	*a*8,210,000	8,588,000	*a*6,090,000	5,933,000	13,596,000	*a*16,815,000
March	9,880,000	10,370,000	10,326,000	8,995,000	13,045,000	*a*18,189,000
1st quar.	26,080,000	27,746,000	22,044,000	20,138,000	....	....
April	11,359,000	11,726,000	12,954,000	12,771,000	11,463,000	*a*17,159,000
May	12,910,000	13,777,000	14,257,000	14,551,000	10,144,000	*a*16,403,000
June	12,382,000	13,538,000	13,307,000	15,036,000	9,168,000	*a*14,903,000
2nd quar.	36,651,000	39,041,000	40,518,000	42,358,000	....	....
July	12,620,000	14,029,000	13,712,000	16,614,000	8,081,000	12,318,000
August	12,967,000	....	14,971,000	....	6,080,000	....
September	13,109,000	....	13,698,000	....	5,533,000	....
3rd quar.	38,696,000	....	42,381,000	....	....	....
October	13,350,000	....	14,285,000	....	4,612,000	....
November	12,603,000	....	10,251,000	....	6,991,000	....
December	9,997,000	....	6,408,000	....	10,900,370	....
4th quar.	35,950,000	....	30,944,000	....	....	....
Prelim. total	137,377,000	....	135,887,000	....	....	....
Amt. of under est.	83,238	....	25,118	....	....	....
Final total	137,460,238	....	135,912,118	....	....	....

a Revised.

The Bureau of Foreign and Domestic Commerce, of the Department of Commerce, reports that the imports of hydraulic cement in June, 1924, amounted to 196,655 bbls. valued at $283,112. The total imports in 1923 amounted to 1,678,636 bbls., valued at $2,964,098.

The imports in June were from Belgium, 116,069 bbls.; Norway, 40,457 bbls.; Denmark, 31,276 bbls.; England, 3,497 bbls.; Sweden, 3,080 bbls.; Germany, 1,782 bbls.; France, 488 bbls.; Canada, 6 bbls. The imports were received in the following districts: Los Angeles, 62,565 bbls.; Porto Rico, 34,398 bbls.; Philadelphia, 33,517 bbls.; Florida, 24,163 bbls.; New Orelans, 11,701 bbls.; Massachusetts, 10,104 bbls.; San Francisco, 7,316 bbls.; New York, 4,986 bbls.; Washington, 4,891 bbls.; Oregon, 3,002 bbls.; other districts, 12 bbls.

The exports of hydraulic cement in June, 1924, were 74,064 bbls., valued at $229,852, of which was sent to South America, 33,750 bbls.; Cuba, 18,909 bbls.; to the other West Indies, 6,543 bbls.; Mexico, 9,502 bbls.; Central America, 2,846 bbls.; Canada, 1,249 bbls.; and to other countries, 1,265 bbls.

The statistics of imports and exports of hydraulic cement in July, 1924, are not available.

Imports and Exports of Hydraulic Cement, by Months, in 1923 and 1924, in Barrels

Month	Imports		Exports	
	1923	1924	1923	1924
January	71,686	153,732	74,169	88,586
February	20,529	162,930	88,531	62,606
March	66,521	160,517	98,861	91,224
April	76,899	148,138	85,662	83,200
May	88,480	161,304	103,634	88,850
June	111,559	196,655	77,203	74,064
July	286,106	*b*	82,774	*b*
August	324,008	......	73,201	......
September	215,785	......	77,121	......
October	172,051	......	74,302	......
November	140,590	......	85,743	......
December	104,422	......	80,487	......
	1,678,636	......	1,001,688	......

a Compiled from records of the Bureau of Foreign and Domestic Commerce.
b Imports and exports in July, 1924, not available.

L. O. X. Lifts 4500 Tons of Rock

By F. W. O'Neil
Chief Engineer, Ingersoll-Rand Co.

From *Compressed Air Magazine.*

Nearly 98,000,000 tons of stone for crushing, for furnace flux, for rubble, for riprap, and for various other purposes was produced by our numerous quarries during the past year. This output represented a substantial increase over that of 1922; and the upward trend continues in this field of industry, which contributes to many needs.

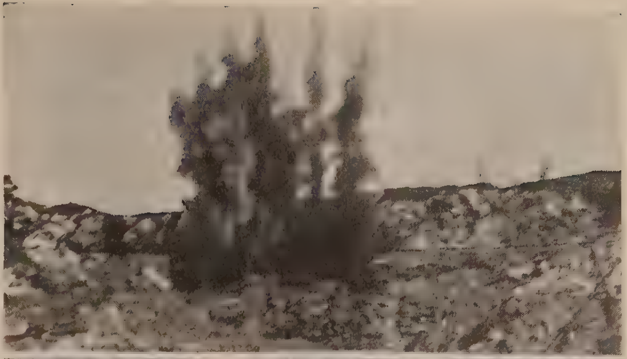
Plainly, the blasting of rock is a much bigger business in this country than most people realize. To shatter and to dislodge this rock from the ledge requires every twelvemonth the use of millions of pounds of powerful explosives. For this work dynamite is extensively employed.

It is self-evident that substantial economies would result if the quarryman had at his command a cheaper and an equally effective blasting agent—in short, one that would answer as well as dynamite and have, besides, some distinctive merits which would make its adoption especially desirable. Happily, such a medium is found in L. O. X.—the accepted abbreviation for liquid-oxygen explosives.

Off and on in this country, both the technical and the popular press have had something to say about this kind of explosives; and a fair percentage of the public is aware that liquid-oxygen explosives were brought to a commercial stage of usefulness mainly through the exigencies of war and the enforced efforts of certain of the European belligerents to conserve their precious stocks of fixed nitrogen.

These informed people also know that L.O.X. has been retained since the cessation of strife as a substitute for dynamite in some important mines abroad, and they are familiar with the fact that the performances of these explosives have been decidedly satisfactory and of much suggestive value. On the other hand, relatively few persons have yet learned that American experts, after much research, have brought the art of manufacturing liquid-oxygen explosives to a more advanced stage than that attained abroad, and are now in a position to give our quarrymen and our mine operators the benefit of these improvements. Probably the measure of this progress can be better understood if we describe a demonstration made recently at a quarry in Pennsylvania. That blast has made it possible for us to draw a direct comparison between the performance of dynamite and L.O.X. when tested under similar service conditions.

On March 5 of the current year, some preliminary blasting was done with L.O.X. at Myerstown, Lebanon County, Pa., on the property of the Calcite Quarry Co., and as a consequence of the excellence of that showing the quarry company gladly assented to a second demonstration. The latter was carried out on April 11 by officials of the Air Reduction Co. and the Ingersoll-Rand Co. who had had to do not only with the designing and the construction of the plant which furnished the liquid oxygen but who also worked out the details for the application of L.O.X. to the blasting of churn-drill holes. It is hardly necessary for us to emphasize that success depends largely upon the get-up of the cartridge. Among the interested spectators were representatives of the mining and quarrying industries as well as others who have to do with the use of explosives.



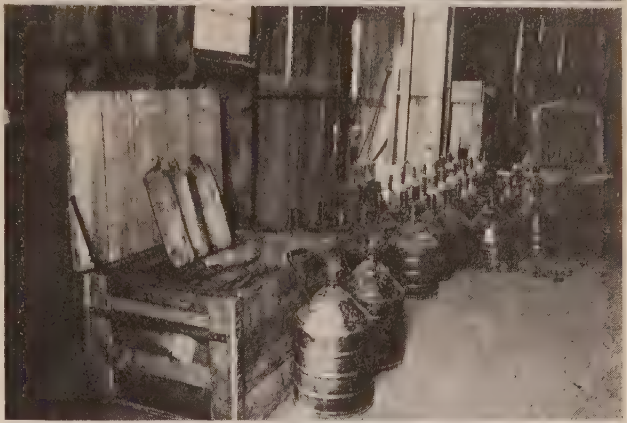


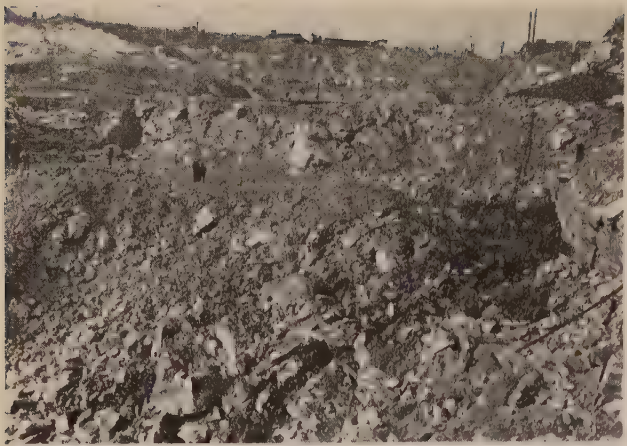
Fig. 1—An Explosion of 721 lbs. of L. O. X. Which Lifted 4,500 Tons of Rock in a Pennsylvania Quarry. The Cloud Was Produced by the Dust of the Red Earth Used to Stem or Fill the Drill Holes Above the Cartridges

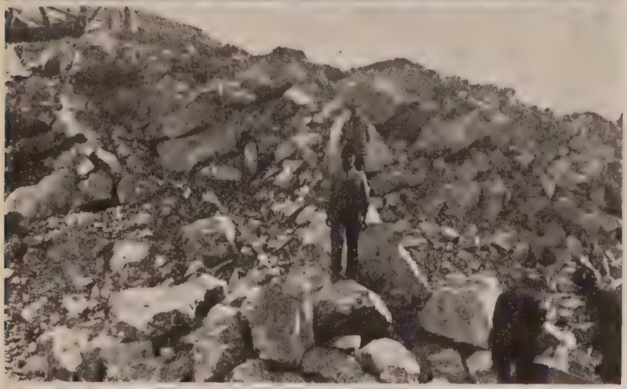
Fig. 2—The Soaking Tank, Some of the Cartridges, and a Number of Insulated Transportation Bottles in Which the Liquid Oxygen Was Delivered from a Distant Plant

Fig. 3—The Bench with the Cartridges in Place Just Before the Blast Was Fired

The object of the second demonstration was to conduct a complete blast in accordance with the usual procedure followed by the Calcite Quarry Co. in its routine operations. This took the form of a 12-hole blast on a 30-ft. bench which was located at one end of the quarry. The drill holes were spaced about 12 ft. apart, as indicated by one of the accompanying illustrations, and each of these holes was 28 ft. deep and 5½ in. in diameter. The cartridges were 5 in. in diameter and 18 in. long—five of them being placed in each hole. For stemming, loose loam was poured into the holes, and none of this material was tamped.

The cartridge cases or bags were made of stout muslin and filled with finely divided carbonaceous material which was of a highly absorbent nature. Before soaking in the liquid oxygen, each dry cartridge, in its complete form, weighed 3.25 pounds—the entire





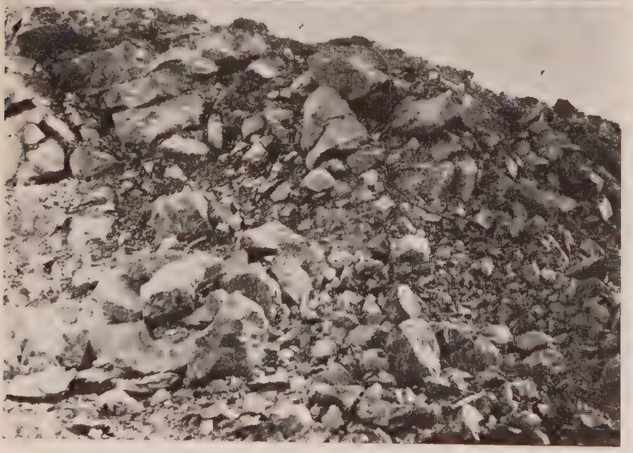


Fig. 4—What Was Left of the Bench After the 60 Cartridges Were Detonated. The Violence of the Explosion is Clearly Indicated By the Manner in Which the Rock Was Broken Up

Fig. 5—In the Foreground Are a Number of Large Pieces of Rock Which Were Block-Holed and Then Blasted by a Small L. O. X. Cartridge in Each of Them

Fig. 6—The Shattered Rock in the Foreground Shows How Effectually the Small Cartridges Fractured the Block-Holed Boulders

lot of 60 cartridges used in the blast weighing in this state 195 bls. As has been determined, each unit of carbon requires for its complete combustion to CO_2 a total of 2.66 units of oxygen. However, the ratio of absorption in the case of the cartridges employed at Myerstown was 3.5 units of oxygen—the excess oxygen allowing a correspondingly longer period in which to load the holes and to make other preparations before evaporation brought the explosives to the CO_2 point. Indeed, the CO_2 point can be passed without materially diminishing the force of the explosion. As a matter of fact, explosive action with cartridges of the kind in question can be obtained any time within two hours after they have been saturated and placed in the drill holes ready for detonating.

The liquid oxygen required for the demonstrating blast was delivered at Myerstown in forty 15-liter transportation bottles—the outward character of which can be seen in one of our illustrations. These containers are so constructed that they minimize evaporation of their liquid-oxygen content while in storage or in transit. When filled and ready for shipment, early in the evening of April 7, the net weight of oxygen in the bottles amounted to 1,541 lbs. When the containers reached their destination in the forenoon of April 11, they held a total of 1,014 lbs. of liquid oxygen —representing a loss of 527 lbs. or 34% during a transportation period of 88 hours. In other words, there was sustained by evaporation a loss of 9.3% for each 24 hours.

When the soaking of the cartrigdes was begun there was available, therefore, 1,014 lbs. of liquid oxygen. Sixty-one cartridges were soaked although but 60 of them were actually utilized for the blast. When the soaking of the entire lot was completed there remained unused 93 lbs. of liquid oxygen—that is to say, each cartridge absorbed substantially 15 lbs. of the fluid, and the whole lot required 921 lbs. for their saturation. The theoretical weight of oxygen needed for 61 cartridges based upon the 2.66 ratio per unit of carbon, is 525 lbs.; and, therefore, the oxygen factor of this demonstration was 1.75—this figure being obtained by dividing 921 by 525. As can be seen, an excess of 75% of liquid oxygen was used over that necessary to insure the cartridges being above or at the CO_2 point after the lapse of a considerable period following their withdrawal from the soaking vessel.

The soaking vessels used abroad are not large enough to accommodate at one time more than a single cartridge of the size fired at Myerstown—the European cartridges being much smaller. This restriction is objectionable, as any practical man can readily appreciate, because of the time that would be required to soak a large enough number of cartridges to meet the needs of a sizable round. To overcome this difficulty, and to make it feasible to soak simultaneously 20 or more cartridges, an insulated tank was built for the quarry demonstration. This was a double-walled, box-like affair having the interspace filled with felt and the soaking chamber lined with copper. One of the illustrations plainly shows the somewhat simple character of this tank. The container proved entirely satisfactory, and the loss of liquid oxygen by evaporation was surprisingly low.

The cartridges were soaked in the liquid oxygen for about 30 minutes. In the first lot 35 of them were so dealt with—enough to load seven holes. Then a second batch consisting of 25 cartridges was soaked, and when ready these were used to load the five holes remaining. The time intervals were as follows: Started to withdraw the first batch of cartridges from the liquid at 2 p. m., and the first set of seven holes was completely loaded by 2:30. Started to soak the second batch at 2:30; and the remaining five holes were loaded by 3:05 o'clock. All twelve holes were shot in unison at 3:35. There was intentionally a lapse of 30 minutes between the time the cartridges were in place in the twelve holes and the moment of firing. In fact, there was a total interval of 1 hour and 35 minutes from the moment the first of the cartridges were taken out of the liquid oxygen until the blast was set off. This point is an important one, for it emphasizes that large quantities of L.O.X. can be used for a single blast and ample time allowed for the deliberate placing of the cartridges, for doing the needful stemming, and for making what other arrangements may be necessary to insure thoroughly effective results.

To fire the 60 cartridges there was hung in each hole from top to bottom a suitable length of TNT Cordeau;

and the twelve lengths of Cordeau were connected above ground to a common trunk—a single cap on the trunk fuse serving to set off all the charges at the same instant when detonated electrically. According to officials of the Calcite Quarry Co., for a similar blast under ordinary conditions they would use 85 lbs. of 40% dynamite in each hole, or a total of 1,020 lbs.

It was estimated that 4,500 tons of rock were broken by the blast or 6.2 tons per pound of L.O.X. employed. Had 1,020 lbs. of dynamite been used instead and a like quantity of rock broken, this would have meant 4.4 tons of rock for each pound of explosive. It was the judgment of those in charge of the demonstration that the blast was overshot and that the same result could have been obtained with 20% less L.O.X.

After the blast, about 15 sizable boulders were block-holed—using in each boulder a cartridge 1¼ in. in diameter and 5 in. long. The explosive broke up the boulders into small fragments. It was conclusively determined that L.O.X. cartridges cannot be detonated in the open air by a fuse but that they will, instead, burn rapidly with a bright flame. This was proved by placing a few cartridges in the open and setting them off with fuses.

Now let us consider the monetary significance of the main performance. Assuming the total weight of the 60 cartridges to be 721 lbs. at the CO_2 point, and putting the cost of the L.O.X. at 8¢ a pound—which is ample to cover fixed charges and loss by evaporation—then the total outlay for the liquid-oxygen explosive amounts to $57.68. On the other hand, with dynamite at 13.25¢ a pound and 1,020 lbs. of it needed, the bill for this explosive would be $135.15. At these rates, the expenditure for L.O.X. for each ton of rick bfoken was 1.28¢, while the use of dynamite for the same service would have cost 3¢. In short, the cost of L.O.X. amounts to but 42⅔% of that of dynamite. If the assumption be correct that the blast was overshot to the extent mentioned, then the outlay for L.O.X. for a specific performance can be put at 34% of that of dynamite.

A marked feature of the effect of the blast was a somewhat pronounced crater formed at the foot of the quarry face when the bench was lifted. This cavity served admirably to indicate the downward force exerted by the L.O.X.; and the measure of this reaction is especially noteworthy when it is recalled that the loam used for stemming was not tamped at all but merely poured into the holes. This stemming was a red clayey earth which photographed black in some of the pictures, and the dust from this stemming was responsible for the density of the cloud blown skyward at the time of the blast.

The liquid oxygen used in this significant demonstration was produced by a plant operating under the Claude system—the system adopted by the Ingersoll-Rand Co. for the manufacture of liquid oxygen in large quantities. This system has been developed by the renowned French physicist, Dr. Georges Claude; and one of the distinctive characteristics of it is that it is necessary to compress atmospheric air to only 1,000 lbs. or possibly less to produce liquid oxygen. By other systems in use, the air must be subjected to an initial pressure of 3,500 lbs. before liquefaction is accomplished. The greater efficiency and economy of the Claude process should, therefore, be self-evident.

The L.O.X. blast at Myerstown was the first of its kind on a commercial scale ever made in a quarry in the United States; and there are the best of reasons for believing that it was the largest blast of liquid-oxygen explosives so far set off anywhere. It was the climax of much work, and marked the overcoming of many obstacles.

Secondary Blasting Methods

By J. B. Stoneking, M. E.

Technical Representative, E. I. du Pont de Nemours & Co., Inc.

From the *Explosives Service Bulletin* issued by E. I. du Pont de Nemours & Co., Inc.

There are very few quarries in which all of the rock is brought down by the first blast in a suitable size for the crushers or the kilns, no matter what the method used in this blasting. This makes secondary blasting generally necessary, the amount depending chiefly upon the purpose for which the rock is to be used, i. e., for riprap, burned lime or crushed stone; the method of loading, whether by hand or by steam shovel; and the size of the primary crushers.

Considerable secondary blasting is also done in contracting work to break the rock small enough to be handled by the steam shovel; on scows and dippers of dredges when rock is brought up too large to go through the dipper or scow; and in open-pit mining. Consequently the subject is worthy of consideration from the standpoint of possible increases in efficiency and economy.

Secondary blasting is done by two methods, blockholing and mudcapping, which latter is also variously styled dobying, bulldozing, plastering, poulticing, pasting and blistering.

In blockholing, a hole is drilled from one-half to two-thirds through the boulder, loaded with a small charge of explosive and tamped firmly to the mouth of the hole. As most of the holes in this work are single holes in separate boulders, cap and fuse firing is more economical than electric and is more generally used, although in some operations electric firing of blockholes is employed, primarily for safety reasons. There are some quarries in hard, seamy, blocky, massive formations where the material is always blasted out by the primary blasting in large blocks, oftentimes so large that the small hammer drills ordinarily used for blockhole work are too small and the heavier tripod drills are resorted to. When the blocks are too large to be broken by single holes and several are drilled in each it is more effective and cheaper to fire these holes simultaneously by the electric method.

Blockholes should always be tamped firmly both to secure the maximum efficiency from the charge of explosive and to prevent premature shots. The latter may be caused by the lighted end of the fuse curling back into the hole and igniting the explosive, or by sparks falling into the open hole from the wicking, cotton rope or other means of lighting the fuse. Tamping covers the explosive and prevents accidents from these sources. Some powder men have the idea that "it is only necessary to keep the air away from the explosive," and simply pour a handful of loose stemming material into the hole on top of the dynamite, thinking that no further tamping is necessary. Experimental tests and actual practice have proved that firm tamping increases the shattering effect of the explosive. Hence if the full effect of the blockhole shot is desired, the hole must be thoroughly tamped to the collar, using the tamping stick to compact the stemming material every three or four inches.

The choice of explosive for blockhole blasting depends to a considerable extent upon the character of the rock, the purpose for which the rock is to be used, the size of crushing equipment, and the method of loading. If the rock is tough, a stronger and faster explosive is necessary than if the rock is brittle, even though it may be hard. If the rock is wanted for riprap, very slow, low-grade explosives should be used. Limestone to be burned in kilns requires a medium low-grade slow explosive as spalls caused by a fast explosive are a waste. Obviously, large crushing machinery with large shovels for loading into the cars does not require so much shattering effect from the explosive as do handloading and small crushers. Generally speaking, fines are a source of trouble and waste in quarry work, outside of the cement industry. Therefore too much shattering in secondary blasting is undesirable.

Red Cross Extra Dynamite in 20% to 40% strengths will generally satisfy most conditions for blockhole work; 20% for easily broken limestone and where large shovels and crushing equipment are in use; 30% for limestone where burned lime is the product; and 40% for the harder rocks such as granite and trap and where the crushing equipment is small.

Durox, Dumorite and Monobel No. 1 are intermediate in strength and action and are satisfactory for blockholing in medium hard rock, besides being very economical on account of the great number of cartridges to the case.

Straight and gelatin dynamites are both used in blockholes but they cost more than any of the above mentioned explosives and generally are not so economical in final results. Gelatin has one advantage in that it does not readily become sprinkled around the borehole where it can be ignited by the spit of the fuse.

The 1 in. x 8 in. cartridge with the holes drilled with 1⅛ in. drill bit will usually give the lowest cost in blockhole blasting. This size cartridge involves less cutting up of cartridges than the 1¼ in. diameter and consequently less waste and less tendency on the part of the blaster to overload. Moreover the smaller-diameter drill hole is easier to start and slightly cheaper to drill.

The mudcap method of blasting consists in placing the explosive in a compact pile upon a flat spot or depression on the boulder and covering it with a mound of wet clay well compacted, the more clay the better for shattering. Mudcapping is growing rapidly into disfavor, chiefly because of the high explosives cost. Roughly speaking, eight to ten times as much explosive is required to break up a given boulder by this method as by blockholing. Furthermore, very quick-acting, high-strength, high-cost dynamite is necessary to secure good results from mudcaps.

Straight dynamite of 40% to 60% strength is preferable for this work, with Red Cross Extra 40% to 60% coming second. In each case the 60% strength will give the best results, as high velocity is the main requisite in mudcapping. Gelatin dynamite, which requires heavy confinement in a borehole to develop its full velocity, is not a good explosive for mudcapping where the confinement is so slight that the speed of the gelatin is about one-half of what it would be if well confined. Durox, Dumorite and Monobel No. 1 can be used in mudcaps but as a rule are not economical as the velocity is not sufficiently high.

A few quarries use mudcaps altogether for secondary blasting, but in order to make it more economical than blockholing the drilling costs must be excessively high. In the majority of quarries mudcapping is resorted to only when boulders are encountered in front of the steam shovels. It requires only a few minutes to prepare a number of mudcaps, whereas the shovel would be delayed much longer if time were taken to drill the boulders. The gain in shovel time here overbalances the extra cost of explosives for mudcapping. In other quarries, when large boulders are uncovered in front of the shovel, they are rolled and nosed around to the inside of the cut and there left to be blockholed after the shovel has passed by. This latter method is as satisfactory and probably as economical of shovel loading time as mudcapping, provided the boulders are not too large to be handled by the shovel without undue strain on the machinery. Broken chains and cables and dipper teeth must be taken into consideration.

Both cap-and-fuse and electric firing are practiced in mudcap work, but the electric method is safer and more economical. In the restricted area in front of the shovel, the boulders to be mudcapped are of necessity close together. Hence with cap and fuse blasting it is a common occurrence for the explosion of one mudcap to displace the charge on the adjoining boulder, sometimes rolling it entirely off on to the quarry floor or scattering the cartridges into the crevices of the rock pile. The primer of this charge usually explodes on the floor or in a crevice, doing no work, hence a complete loss, while the balance of the charge is scattered about as a potential menace to the dipper teeth and shovel crew. In electric firing this loss and possible source of accidents are avoided as all charges detonate simultaneously.

When fuse is used for secondary blasting it should be of good quality, at least a grade recommended for damp work. A good many quarries use a cotton fuse for this work because it is the softest and least elastic of all the brands of fuse. When it is laid out on the rock it stays where it is placed. However, both hemp and cotton fuse are too small to fit a blasting cap properly and furthermore are far from waterproof. Even a small amount of moisture on the rock or in the mud may cause a misfire with these brands of fuse. If they are used, the cap should be crimped with broad-nose pliers, not with a cap crimper, as the latter is not designed to be used with so small a diameter of fuse. The burning speed of the fuse in use should be known and the fuse lengths calculated so as to give the blaster time to reach a place of safety after lighting all the fuses. The best practice is to cut the required number of fuse lengths and crimp the caps on them before starting to load the holes.

The quantity of explosive in any one blockhole or mudcap shot is small, to be sure, but when it is taken into consideration that of the three hundred million pounds of high explosives used every year in the United States, possibly one-sixth is used in quarrying and other open-pit operations, and that possibly one-quarter of this sixth is consumed in secondary blasting, then it becomes apparent that practices leading to economy in secondary blasting are worth while.

Ohio-Tennessee Freight Rates

A proposed freight rate increase of one cent per 100 lbs. on cement from various Ohio and Mississippi river crossings and points taking the same rates to Knoxville, Tenn., has been suspended until December 3 by the Interstate Commerce Commission. The increase was filed to become effective August 5 as published in Supplements Nos. 2, 3, and 4 to Agent F. L. Speiden's tariff I. C. C. No. 796. The present rate to Knoxville from Cincinnati of 15¢, from Cairo of 18¢, from St. Louis of 25¢ and from Memphis of 16¢, would be increased to 16, 19, 26 and 17¢ per 100 lbs. respectively on carload traffic. The cities named are representative points of origin.

How 32 Lost Lives In Cement Industry

From the July-August .1924, issue of *Accident Prevention Bulletin*, of the Portland Cement Association.

During the first half of the year there have been 32 fatal accidents in the industry. Too many by far. Assuming that experience is the best teacher it would seem to be very desirable if we could get the information contained in the accompanying list to the attention of each and every workman at cement plants so that they will know not only that 32 men have died prematurely, due to accidents of a preventable nature, but also will be acquainted with all the details in connection with the accidents. It is strongly recommended that you copy this list, write a short signed message to accompany it and post it on your bulletin boards. Have a full discussion of all the cases at your safety meetings.

Fatal Accidents During First Half of 1924

1. Cleaning choke in drier feed, clothing was caught in sprocket and chain.
2. All dynamite in a small drill hole had not exploded and when two hours after preparation was made for additional drilling the remaining dynamite exploded.
3. Premature explosion while lighting fuses during block holing.
4. Was sitting on screw conveyor box, coat tail was caught in screw.
5. Working on scaffold attached to deck of movable forms inside sack house. Scaffold broke causing man to fall 42 ft.
6. Covered by slide in crushed rock stock-house while digging down material.
7. Was caught on smooth line shaft about 2 ft. from floor while cleaning with air hose.
8. Standing on frozen crushed stone pile which had been undermined, stone caved in and covered the man.
9. Deceased was shoveling stone in bin. He was wearing safety belt and rope but had allowed too much slack in the rope so when a slide took place he was carried with it and as the rope broke it was impossible to rescue the man.
10. Killed by rolling stone from quarry face.
11. Left arm caught between pulley and conveyor belt and body was drawn between belt and pulley.
12. Crawled under quarry cars to protect himself from blast. Cars were moved and passed over the man.
13. Coat caught on crusher coupling and man was whirled around the shaft.
14. While assisting in building scaffold a 2x6 knocked off the roof struck man on head as he came up ladder.
15. Hit by frozen clay and rock which rolled from quarry face.
16. While barring stone from quarry face a slide took place.
17. Connecting water hose to pipe on locomotive to take on water, a rock from a stone car struck man on head.
18. Man was found on roof in contact with high tension wires.
19. While standing on top of kiln assisting in hoisting smoke ring when in some manner the smoke ring became unfastened from the tackle and the man, having hold of hoisting rope, fell to the floor, head first.
20. When firing boiler, tube burst, blowing fire and steam through fire door.
21. Fell into rock bin. Neck broken in fall.
22. While helping on locomotive crane the man was caught between revolving crane and stationary crane table.
23. Man stepped in front of drifting quarry car and was run over.
24. Foot slipped through grating over screw conveyor. Foot was amputated but blood poisoning set in and the man died about two weeks after the operation.
25. Premature explosion of powder being dropped into well drill hole.
26. Deceased was engaged as a sweeper. His duties were to keep certain portions of the building clean, namely—floors under kominuters and tube mills, top of kominuters and tube mill tanks. The operators themselves do all their own cleaning around the machines.

    The circumstances which led up to the accident, are as follows: at 9:40 a. m. numbers 7, 8, 9 and 10 kominuters were operating. The miller reported to his foreman that No. 10 had two broken bolts in the hub. The operating foreman immediately reported same to the repair foreman, who got two bolts ready and detailed one of his repairmen to have the machine shut down and replace the bolts as soon as he got his necessary tools together. At 9:45 a. m. the chain driving the kominuter screw conveyor jumped off; this caused the miller to immediately stop all the kominuters. The miller replaced the chain, also started up the screw conveyor motor and was then proceeding to start the kominuters. At this point the repairman met the miller and asked the miller if he would give him a hand to put the bolts in the gear when he, the repairman, was ready. The miller replied that he would do so and went on with the operation of starting up the kominuters. At 9:54 he started No. 8 kominuter, the next one to start being No. 10 he turned to that switch and just pushed the switch over to the starting side when he heard a shout from the repairman. He let go the switch and rushed up to the kominuter platform to see what was the matter. There he found the repairman supporting the deceased, who was caught in the gear. The machine had traveled one-half of a revolution.

    The repairman said he did not see the deceased until the mill started, he then saw him disappearing head first down between the concrete pier and the gear.

    It is supposed that the deceased, who understood and spoke very good English and was an exceptionally bright and willing worker, overheard the repairman ask the miller for help to replace the bolts. The deceased went around to the gear, probably thinking that the mill was not to be started up again, lay down on the pier close to the gear and began to work on taking out one of the bolts. As the mill started up it caught him and carried him right under, fracturing his skull.

    The repairman was not quite ready to make the repairs and did not ask the miller to stop the machine for him at this time.

    In the case of a machine being down for repairs the repairmen have locks to lock the switch box on the particular mill they are working on to make sure that the mill is not started while they are working there.
27. Covered by slide in raw material bin. The man was alone on the job and did not use life belt and rope.
28. The man was employed as oiler and sweeper. A screw conveyor appeared to be blocked and when the mill operator investigated he found deceased in a pit under the driving pulley of the screw conveyor. The man was dead when found.
29. Got splinter in finger while repairing cab on dinkey. The man kept on working for five days. He was taken to the hospital ten days after the accident but blood poisoning had then become so severe that he died the next day.
30. While oiling, clothing caught on shaft. The man was whirled around in a small space and was killed instantly.
31. Went up bank to shoot a big stone when the bank gave way and large stone rolled over the man. He had been warned of the danger by two other workmen.
32. Electrocuted.

Far East Construction Lags

G. S. Brown, president of the Alpha Portland Cement Co., who has just returned from a three months study of conditions in the Far East, summarized as follows his observations on the construction industry in Japan, China and the Philippines:

The anticipated construction program of the Japanese to replace the buildings lost by earthquake and fire last year has failed to materialize. Temporary structures sufficient to house the people have been erected but little permanent construction has been started and when I was there no one seemed to have any knowledge as to when active, permanent reconstruction would be started.

There is a surplus in Japan of all sorts of construction materials. Indeed the construction industry is in a depressed condition in all parts of the Far East except in Hong Kong and Shanghai. The disturbed political condition in China prevents any extensive work, while in the Philippines fear that the Islands will be given independence by the United States has the same effect.

In Hong Kong and Shanghai, however, there is a very large construction program in process. It is said this is financed by wealthy Chinese from the interior of China who are fearful that they will lose their wealth because of the present disturbed political conditions and are therefore putting it in Hong Kong and Shanghai where the English insure stability of government.

Of the nations of the world outside of the United States, Japan is one of the largest producers of portland cement. Not only Japan but China and the Philippines, also, prepared for what was supposed to be a very greatly increased demand for cement because of the reconstruction of the devastated areas in Japan. Failure of this program to materialize has resulted in a very depressed condition and a lower price for cement than has ever been known in the Orient. Japanese cement is of high quality as is also the Philippine product. Cement manufactured in China and Indo-China is not nearly so good.

The present low price, as nearly as can be found out, is about equivalent to the prices netted by mills in the United States and I was told that many of the manufacturers were operating at a loss at these prices.

I was very forcibly impressed by the fact that despite this low price for cement and the highest wages known in those countries yet a workman in one of the cement factories in the Orient who might wish to use a barrel of cement about his home—if he were fortunate enough to have one—would be obliged to work, roughly, three days in order to make sufficient money to purchase it while the average workman in the cement mills of the United States earns enough in one day to purchase three barrels of cement.

New Lime Hydrate Plant in Utah

By L. D. Roueche

In the past, mining has been a more or less haphazard search for high grade ores, but in recent years a new idea has been growing in the minds of the leaders of the mining industry, and as a result no opportunity is overlooked for utilizing and exploiting every product from which a profit can be netted. In this direction the Chief Consolidated Mining Co. of Eureka, Utah, has probably gone as far as any western mining company. This company is constantly studying new methods and searching out new resources, employing a large corps of metallurgical and engineering experts for this purpose.

One of the latest manifestations of the company's policy to overlook no opportunity of increasing its revenues is the construction of a new hydrated lime plant at Homansville. With the completion of this plant the company is prepared to furnish all types of lime products as well as high calcium limestone for sugar manufacturer's use, in large or small quantities. It is believed that this field offers a remarkable chance for profit and growth.

A careful study of the vast limestone deposits situated at Homansville and a comparison with other limestone deposits in all parts of the country, has convinced the company that nowhere is there as large and high-grade a tonnage of raw material which, when properly refined, can be used in a score of industries and for hundreds of purposes.

When the Chief Consolidated decided to enter the lime manufacturing industry, H. A. Major, formerly superintendent of the Utah-Idaho Sugar Co., was put in charge of the company's lime and lime rock department.

Before undertaking the construction of the hydrated lime plant, Mr. Major visited over thirty plants in the United States to study problems related to the making of this particular product. The new plant embodies the best features of all of these plants; it is electrically operated throughout and is probably the most modern plant of its kind in America.

New Methods Used

The limestone from which the hydrated lime is manufactured is broken in the quarry by drilling and blasting. Care is taken not to break the rock too fine. From the quarry the rock is conveyed approximately a distance of 200 yds. to the hydrating plant by team. Teams will soon be supplanted by an aerial tramway which will convey the rock and dump it directly into the bins at the mill.

The storage bins are so constructed that the limestone feeds itself into the kilns. Instead of the old system of burning the limestone by direct firing, that is mixing the coal and the rock together, the fire box is built so that only the flame comes in contact with the raw product in the kiln. The carbon dioxide is drawn off by electric fans placed at the top of the circular kilns. The kilns themselves are of the steel jacket type, lined with 2 ft. of fire brick and insulated with 4 in. of Cil-o-Cel.[1] It is claimed that this amount of Cil-o-Cel is equal in insulating quality to 4 ft. of brick. By this construction the utmost efficiency is derived from the fuel.

To make the best product it has been found that a long steady mellow flame is necessary and in order to maintain the right kind of flame with a minimum waste of fuel, electric recording pyrometers, draft and pressure gauges are included in the firing equipment.

When the limestone at the bottom of the kiln is as transparent as glass—a state that is attained when the rock has been in the kiln for about forty-eight hours—it is drawn off and laid on the cooling floor where it is carefully sorted for any waste or imperfectly burned pieces.

From the cooling floor the burnt limestone is conveyed to a Sturtevant crusher[2] and pulverized to a maximum of ¼ in., then it is elevated by a 24-in. Weller elevator[3] to a steel storage tank of 40 tons capacity. At the bottom of this tank is a 10-in. steel scroll conveyor which takes the lime from the tank and discharges it into an elevator which carries it to the third floor of the hydrate plant. Here it is dropped into an automatic scale. When the desired quantity is in the scale, generally about 1500 lbs., the scroll conveyor and the elevator are stopped and the lime is dropped from the scales into the hydrator where the necessary amount of water to accomplish the hydration is added.

Cooling and Drying

After complete hydration, the lime is passed from the bottom of the hydrator into a steel hoppered tank of 22 tons capacity, to which is attached a 20-in. patent Raymond feeder,[4] which feeds the mass into a cylindrical cooler 25 ft. long and 6 ft. in diameter equipped with stirring arms throughout the entire length. These arms keep the hydrate in continual motion thus aiding in driving off the excess moisture and heat. It also discharges the material when dry into a Raymond pulverizing mill where it is ground to 200 mesh, the coarse particles being sieved out.

Attached to the bin is a Bates four-valve bag packing machine[5] which automatically weighs, fills and seals the hydrated lime in 10-lb. or 50-lb. paper sacks.

Modern in Every Detail

The plant is built of concrete and steel, covered with galvanized iron. There are no belts or shafts and all the equipment is electrical. The whole plant can be operated by an automatic switch and electric push button system. The utmost safety precautions have been taken, steel railings have been installed and all motors and machines have been housed over. The entire plant has been constructed so that the capacity can be tripled in a short time and the capacity increased from 30 to 90 tons of hydrated lime. Ample storage facilities have been provided and orders for any amount can be filled on short notice.

French manufacturers of chemical laboratory and plant equipment are not finding the home market sufficiently active to absorb their production of apparatus and are looking for export outlets. Business in the United States is their aim, according to the report of a representative of the National Exposition of Chemical Industries, who is now in Europe.

Requests from European manufacturers of chemicals, dyestuffs, plant machinery, and instruments, for space in the 1925 Chemical Exposition have been received in larger numbers this year than on any previous occasion. German, Swiss, French, and British manufacturers are anxious to display their goods in the American exposition when it is held at the Grand Central Palace, New York, Sept. 28 to Oct. 3, 1925.

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[1] Celite Products Co., New York City.

[2] B. F. Sturtevant Co., Hyde Park, Mass.

[3] Weller Mfg. Co., Chicago, Ill.

[4] Raymond Bros. Impact Pulverizer Co., Chicago, Ill.

[5] Bates Valve Bag Co., Chicago, Ill.

Men and Mills

Notes from the Field

G. S. Brown, president of the Alpha Portland Cement Co., Easton, Pa., has just returned from a three months study of conditions in the Far East.

The Superior Portland Cement Co., has been awarded a contract to furnish 500,000 bags of cement to be used in the construction of a dam 7 miles in length and three-quarters in width in the Baker river, Washington.

The directors of the Nazareth Cement Co., Nazareth, Pa., have elected the following officers: president, M. J. Warner, Pine Orchard, Conn.; vice president, A. L. Ferguson, Stamford, Conn.; secretary and treasurer, George F. Coffin, Easton, Pa.

A bucket tram line more than a mile long is contemplated by the Superior Portland Cement Co., Concrete, Wash., to carry quarry rock to the mill.

The Worthington Pump & Machinery Corp., New York, has placed a repeat contract with the Austin, Co., engineers and builders, Cleveland, for the construction of a new unit at its Buffalo branch plant, calling for a pattern storage building 80 ft. x 200 ft. two stories high.

Another unit increasing the present output of the Hermitage Portland Cement Co., by 50% is now being planned, the great demand for the company's product warranting the increase, according to the general manager.

The last of the scrap iron from the fire in the Brixment mill of the Louisville Cement Co., Louisville, Ky., has been cleaned up but the mill is running only four days a week as the bulk house is full.

Reuben Miller has become engineer at the Giant Portland Cement Co.'s plant, Egypt, Pa.

Joseph Horner, Bath, general manager of the Nazareth Portland Cement Co., for 12 years, has resigned.

Work on a concrete road, which the Whitehall Portland Cement Co., contracted for between its plant in the southern part of Cementon and North Coplay, has been completed by the General Paving Co. The cement company built the road at its own expense by agreement with the county and township.

The Clinchfield Portland Cement Corp., of Kingsport, Tenn., has opened a new branch sales office at 1511 Healey Bldg., Atlanta, Ga. Work is also progresing on the company's new plant at Coreen, Ga., and the new office is established to take care of the business in that section when the new plant is in operation according to a report from Maryland.

More than 16,000,000 lbs. of explosives were used in cement quarries of the country last year, according to the Portland Cement Association's ready reference book on the cement industry and concrete.

The Giant Portland Cement Works has augmented its quarry equipment with a new locomotive.

F. W. Kelley, president of the Portland Cement Association and of the Helderberg Cement Co., Albany, sailed for London the week of August 9 on the Aquitania to address cement makers from various parts of the world attending a convention in London early in September to commemorate the 100th anniversary of the invention of portland cement.

The opening of the new Pacific Portland Cement Co.'s plant at Redwood City, Calif., recently, has caused several changes in the personnel of the company at Cement, according to report from that section. H. M. Power, superintendent at Cement will go to Redwood City, M. J. Johnson taking his place; L. E. Bostwick traffic superintendent at Cement will be succeeded by C. L. Coffey; and H. M. Larmour, chemist, will be succeeded by John Butler. Mr. Bostwick and Mr. Larmour will go to Redwood City.

The Fuller-Leihgh Co., Fullerton, Pa., has recently made the following installations:

A Fuller pulverized coal feeding and burning equipment and a Fuller-Kinyon transport system for the Louisville Cement Co., Speeds, Ind.; Fuller coal feeding and burning equipment for the Kosmos Portland Cement Co., Kosmosdale, Ky., and the Crescent Portland Cement Co., Wampum, Pa.; a screen type Fuller mill in the coal grinding department of the Nazareth Cement Co., Nazareth, Pa.; Fuller Pulverized coal feeders and burners for the Diamond Portland Cement Co.; one gear driven, screen type Fuller mill and indirect pulverized coal fired rotary dryer for the Lehigh Portland Cement Co., Birmingham, Ala.; screw feeders and burners, and a Fuller-Kinyon transport system for the Peerless Portland Cement Co., Detroit, Mich.; coal feeding and burning equipment for the Wolverine and Southwestern Portland Cement Companys at Coldwater, Mich. and El Paso, Tex., respectively; gear driven screen type Fuller mills for the Bay Bridge, Ohio, plant of the Sandusky Cement Co., the Marquette Cement Mfg. Co., and the Cayuga Operating Co., a subsidiary of the Pennsylvania Cement Co., Portland Point, N. Y.; and a Fuller-Kinyon transport system for conveying pulverized coal for the Pennsylvania Cement Co., Bath, Pa., the Lawrence Portland Cement Co., Northampton, Pa., the Edison Portland Cement Co., New Village, N. J., the Dexter Portland Cement Co., Nazareth, Pa., and the Sun Portland Cement Co., Lime, Ore. The Fuller Lehigh Co. has also installed a Fuller pulverized coal feeding and vertical burning equipment on a waste heat boiler in the new plant of the Southwestern Portland Cement Co., at Osborn, Ohio.

Chemical Exposition 1925

Owing to some confusion which is believed to exist in a few quarters regarding the holding of the next chemical exposition, an announcement has been sent out by the International Exposition Co., under whose management the Exposition of Chemical Industries has been held since 1915 that there will be no chemical exposition this year. The next Exposition of Chemical Industries will be held September 28 to October 3, 1925, at the Grand Central Palace, New York.

Gun for Removing Clinker Rings

The menace to the uninterrupted operation of cement kilns in many localities on account of clinker rings has prompted the Remington Arms Co. to make a new gun with a special mount for the front of the kiln, so that when rings appear the gun may be attached and the rings broken up. The kiln can then be operated normally with practically no loss of time or product. The Remington company has under way the manufacture of 10 guns which, it is expected, will be available in a few months.

The results so far obtained indicate that the new type of gun will prove a solution never before obtained of an annoying condition in many cement plants.

Preparations of Super-Refractories

An investigation having for its purpose the production, by electric furnace methods, of materials of higher refractoriness than those commonly used in commercial practice is being conducted by the Department of the Interior at Seattle, Wash., experiment station of the Bureau of Mines. Such refractories have been called super-refractories. The first material to be investigated is sillimanite. Two methods of preparing the material are being studied, namely, (1) From a mixture of clay and aluminium oxide in the form of bauxite, diaspore, or alunite residue; (2) From clay alone by removing the requisite amount of silica and the iron by melting with carbon in the electric furnace. The material thus produced in the electric furnace is then subjected to the methods of testing refractory materials, and is fashioned into brick and other shapes and given both refractory and commercial tests.

Encouraging progress has been made in this investigation. It is expected that the work on sillimanite will be completed during the present fiscal year, and that another material will be taken up.

Trade Publications

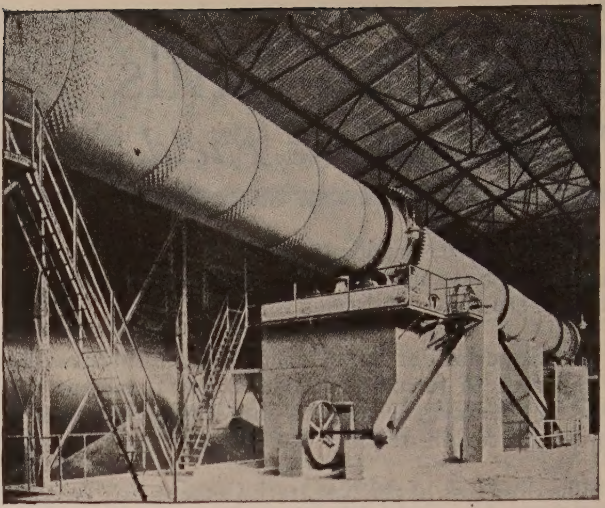
A general catalog, No. 9, has been issued by the American Manganese Steel Co., Chicago Heights, Ill., under the title *Amsco Manganese Steel Castings*. This is a work of some size and considerable importance to readers as it contains a large and interesting body of information and data regarding both the general subject of the manufacture and application of manganese steel, and, specifically, the varied types of castings and equipment with their uses.

The catalog contains information of interest to industrial plants of all kinds such as steel mills, blast furnaces, cement plants, foundries, and in fact, all plants using equipment that is subject to wear and tear. The book suggests many applications of the use of manganese steel, designed to result in increased production and lower cost.

Of particular interest to cement and lime manufacturers is the specialized book, *Manganese Steel Castings for Quarries*, which contains information relative to the design and construction of the patented Missabe dipper, dipper teeth, miscellaneous manganese steel castings for power shovels, crushers, screening machinery, conveying equipment, etc.

The general catalog No. 9, covers the entire ground as far as the diversified character of the manganese steel founding industry permits. The other books of the series are specialized books formed by eliminating certain sections not relevant to a given industry.

The books are clearly illustrated by reproductions of drawings and photographs on pages 8½ in. x 11 in.



Tests That Show Fire Brick Value

To give maximum service, fire brick must be not only uniform in composition and dimension, but must also resist spalling, slag penetration, expansion and contraction.

The Slag Penetration Test

Cavities drilled in Ashland Brick and filled with open hearth slag were placed in the furnace at 1350 C. by the Mellon Institute of Industrial Research. After two hours, Ashland Crown showed absolutely *no* slag penetration. In Ashland Savage, the slag had penetrated *only* .13 of an inch.

The Spalling Test

In laboratory tests, Ashland brick, alternately heated to 2432 F. and plunged into cold water ten times, show a loss of less than 20%.

The Expansion and Contraction Test

Under the conditions imposed by the American Society of Heating Materials, Ashland steam pressed brick show an expansion test of only ½ the permissible variation. Ashland hand-moulded brick show ⅓ the amount of contraction allowable under the same conditions.

The ability of Ashland Fire Brick to withstand these conditions assures long service at minimum cost. Use Ashland Fire Brick for every refractory purpose.

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FIRE BRICK CO.
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